# NAVAL POSTGRADUATE SCHOOL

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# THESIS

## STUDY OF PERSONNEL ATTRITION AND REVOCATION WITHIN U.S. MARINE CORPS AIR TRAFFIC CONTROL SPECIALTIES

by

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March 2012

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This thesis evaluates U.S. Marine Corps Air Traffic Control (MATC) military occupational specialties (MOSs) to determine methods of reducing personnel attrition from the MATC Basic Course and revocation from operational forces.  The author analyzes Marine Corps personnel data obtained from the Total Force Data Warehouse and Headquarters Marine Corps.  The range of the data analyzed covers a period from fiscal years 1999 through 2008, including 965 MATC Marines.  Multivariate regression models are estimated to determine the effects of AFQT score, ASVAB composite scores, demographics, and other measures of performance on the likelihood of personnel attrition and revocation. Results indicate that changing selection criteria for AFQT score or ASVAB composite scores is not warranted. It is recommended that current selection criteria be augmented with improved medical screening at Military Entrance Processing Stations (MEPS) and recruit depots, to include non-cognitive testing, such as Navy Computer Adaptive Personality Scales (NCAPS), during recruitment. It is also recommended that an economic analysis be conducted comparing the cost of personnel losses during training with the cost of losses due to revocation.

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# ABSTRACT

This thesis evaluates U.S. Marine Corps Air Traffic Control (MATC) military occupational specialties (MOSs) to determine methods of reducing personnel attrition from the MATC Basic Course and revocation from operational forces. The author analyzes Marine Corps personnel data obtained from the Total Force Data Warehouse and Headquarters Marine Corps. The range of the data analyzed covers a period from fiscal years 1999 through 2008, including 965 MATC Marines. Multivariate regression models are estimated to determine the effects of AFQT score, ASVAB composite scores, demographics, and other measures of performance on the likelihood of personnel attrition and revocation. Results indicate that changing selection criteria for AFQT score or ASVAB composite scores is not warranted. It is recommended that current selection criteria be augmented with improved medical screening at Military Entrance Processing Stations (MEPS) and recruit depots, to include non-cognitive testing, such as Navy Computer Adaptive Personality Scales (NCAPS), during recruitment. It is also recommended that an economic analysis be conducted comparing the cost of personnel losses during training with the cost of losses due to revocation.

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# LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| **ACA1** | Air Traffic Control Basic Course |
| **AFQT** | Armed Forces Qualification Test |
| **AMERINDIAN** | Native American |
| **AO** | Assembling Objects |
| **APX-25** | Headquarters Marine Corps, Expeditionary Enablers Branch, Command and Control Group-25 |
| **AR** | Arithmetic Reasoning |
| **AS** | Auto and Shop Information |
| **ASVAB** | Armed Services Vocational Aptitude Battery |
| **ATC** | Air Traffic Control |
| **ATCS** | Air Traffic Control Specialist |
| **AWT** | Airman Written Test |
| **BUD/S** | Basic Underwater Demolition/SEALs |
| **CNA** | Center for Naval Analyses |
| **CL** | Clerical |
| **CO** | Commanding Officer |
| **CTO** | Control Tower Operator |
| **DoD** | Department of Defense |
| **EI** | Electronics Information |
| **EL** | Electronic |
| **FCGs** | Final Course Grades |
| **FY** | Fiscal Year |
| **GAO** | General Accounting Office |
| **GED** | General Equivalency Degree |
| **GT** | General Technical |
| **HSD** | High School Diploma |
| **HQMC** | Headquarters Marine Corps |
| **IADS** | Integrated Air Defense System |
| **JPM** | Job Performance Measurement |
| **MACCS** | Marine Air Command and Control System |

| | |
|---|---|
| **MACS** | Marine Air Control Squadron |
| **MAGTF** | Marine Air Ground Task Force |
| **MARADMIN** | Marine Administrative Message |
| **MARDET** | Marine Detachment |
| **MATC** | Marine Air Traffic Control |
| **MC** | Mechanical Comprehension |
| **MCAF** | Marine Corps Air Facility |
| **MCAS** | Marine Corps Air Station |
| **MCO** | Marine Corps Order |
| **MCRD** | Marine Corps Recruit Depot |
| **MEPS** | Military Entrance Processing Station |
| **METs** | Mission Essential Tasks |
| **MK** | Mathematics Knowledge |
| **MM** | Mechanical Maintenance |
| **MOS** | Military Occupational Specialty |
| **MOSs** | Military Occupational Specialties |
| **MoMD** | Manual of the Medical Department |
| **NAS** | Naval Air Station |
| **NATTC** | Naval Air Technical Training Center |
| **NAVMED** | Navy Medical Order |
| **NCAPS** | Navy Computer Adaptive Personality Scales |
| **NMOS** | Necessary Military Occupational Specialty |
| **NPRST** | Navy Personnel Research, Studies, and Technology |
| **NPS** | Naval Postgraduate School |
| **OccFld** | Occupational Field |
| **PC** | Paragraph Comprehension |
| **PEF** | Program Enlisted For |
| **PMOS** | Primary Military Occupational Specialty |
| **PSI** | Personnel Security Investigation |
| **SCI** | Sensitive Compartmented Information |
| **SEAL** | Sea, Air, and Land |
| **SIAP** | Single Integrated Air Picture |

| | |
|---|---|
| **SMEs** | Subject Matter Experts |
| **TFDW** | Total Forces Data Warehouse |
| **T&R** | Training and Readiness |
| **VE** | Verbal Expression |
| **WK** | Word Knowledge |

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# I.    INTRODUCTION

## A.    BACKGROUND

The U.S. Marine Corps Air Traffic Control (MATC) Military Occupational Specialties (MOSs) have historically experienced among the highest personnel attrition and revocation rates of any Marine Corps enlisted aviation occupation. The requirements for attaining and retaining a MATC MOS are outlined in the Marine Corps Order 1200.17B, *Military Occupational Field Manual* (Short title: MOS Manual) and Marine Administrative Message (MARADMIN) 230/04, *MOS Skill Designations for Marine Air Traffic Controllers*.[1,2]

For the purposes of this study, the term "attrition" refers to both the unscheduled discharge of personnel during a first term of enlistment (a recruit who fails to complete an enlistment contract and leaves the Marine Corps) and the failure of personnel to complete a primary training course (which may result in reassignment rather than discharge from the Marine Corps).  Revocation is defined as the dismissal of personnel after assignment to a Primary MOS (PMOS).  This breaks from the more traditional usage of "attrition" and "revocation" by military manpower researchers, yet it is consistent with the vocabulary used by the Marine Corps.

Selection into training for MATC is predicated on meeting the following criteria: [1] receiving a General Technical (GT) score of 110 or higher on the Armed Services Vocational Aptitude Battery (ASVAB); [2] meeting the qualifications for a Class II military physical; [3] possessing normal color vision; and [4] qualifying to obtain a Secret level security clearance.[3]  These standards identify and codify personnel skill requirements for entrance into the MATC training pipeline.  A 2011 study by Northrop

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[1] U.S. Marine Corps, Marine Corps Order 1200.17C, *Military Occupational Field Manual* (Short title: MOS Manual) (Washington, DC: Department of the Navy, 2004).

[2] U.S. Marine Corps, Marine Administrative Message (MARADMIN) 230/04, *MOS Skill Designations for Marine Air Traffic Controllers* (Washington, DC: Headquarters, Marine Corps, 2004).

[3] U.S. Marine Corps, *MOS Manual*, 3.568.

Grumman suggests these criteria alone are not maintained in the selection process and inadequate in predicting the likelihood of attrition or revocation.[4]

A new metric for screening potential Marine Corps Air Traffic Controllers, which includes current MOS Manual selection criteria, has the potential to additionally reduce MATC personnel attrition and revocation rates. Further refinement of medical screening techniques and the introduction of testing that measures non-cognitive traits (behavior, attitudes, and interests), such as the Navy Computer Adaptive Personality Scales (NCAPS), may provide additional quantifiable metrics to help reduce personnel attrition and revocation.

## B.    PURPOSE

The purpose of this thesis is to examine the relationship between demographics, education level, ASVAB test scores, and fiscal years of primary training to ascertain whether additional screening criteria would improve predictability of personnel attrition from the MATC Basic Course or revocation from MATC MOSs.

## C.    RESEARCH QUESTIONS

### 1.    Primary Research Question

How effective are current screening criteria in predicting personnel attrition and revocation in MATC MOSs?

### 2.    Secondary Research Question

Could additional screening criteria aid in more effectively predicting personnel attrition and revocation for MATC MOSs?

## D.    SCOPE AND LIMITATIONS

This thesis compares the predictive effectiveness of current screening criteria used in assigning enlisted personnel to MATC MOSs with that of additional screening criteria. The ultimate objective is to see if current criteria can be improved to more accurately

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[4] Marine Corps Studies Program Support, *Marine Air Traffic Control Training and Revocations Study* (Fairfax, VA: Northrop Grumman Information Systems, 2011), 4.9.

predict personnel attrition and revocation. The author analyzes Marine personnel data from the Total Force Data Warehouse (TFDW) and Headquarters Marine Corps, Expeditionary Enablers Branch, Command and Control Group-25 (APX-25). The data studied cover the period from fiscal year (FY) 1999 through FY 2008.

## E.     ORGANIZATION OF THE STUDY

This thesis is organized into six chapters. Following this introduction, Chapter II provides further detail about the Marine Corps Military Occupational System selection criteria, the ASVAB, medical and security requirements for MATC personnel, non-cognitive attributes associated with air traffic control, and the typical career progression of a Marine Air Traffic Controller. Chapter III describes the methodology, techniques, and key findings of previous research that relate to the present study. Chapter IV presents the results of preliminary data analysis. Chapter V describes the research methodology for the regression models and presents the results. Chapter VI summarizes the study results and closes with conclusions and recommendations.

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## II.    BACKGROUND

This chapter provides background information considered important for understanding the objectives, methodology, and results of the present study.    The following topics are addressed: the Marine Corps Military Occupational System selection criteria; the Armed Services Vocational Aptitude Battery (ASVAB); medical and security clearance requirements for Marine Corps Air Traffic Control (MATC) personnel; the non-cognitive attributes associated with air traffic control; and the standard career progression of Marine Corps air traffic controllers.

The chapter first outlines how specialties are designated within the Marine Corps and summarizes how the ASVAB is used for assigning recruits to the MATC Military Occupational Specialty (MOS).    The chapter then describes the medical and security requirements outlined in the MOS Manual and how these requirements apply to selection and retention of MATC personnel.    The chapter further details the prominent non-cognitive attributes associated with air traffic control and discusses how these characteristics are used for screening potential MATC candidates. The chapter concludes with an analysis of the career progression possibilities for a typical Marine Corps Air Traffic Controller.    Together, these sections provide an overview of the mechanisms utilized by the Marine Corps to select and retain Marines within MATC MOSs.

### A.    MARINE CORPS MILITARY OCCUPATIONAL SYSTEM

The Military Occupational System is the framework utilized by the Marine Corps to classify and assign personnel to specific occupational categories.    The system identifies and codifies personnel skill requirements and establishes training standards to build and maintain a personnel inventory.[5]  Occupations with similar skill and knowledge requirements are grouped into functional areas known as Occupational Fields, enabling effective classification, assignment, promotion, and utilization of personnel.[6]

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[5] U.S. Marine Corps, *MOS Manual*, iv.

[6] Ibid.

An Occupational Field (OccFld) groups related MOSs by the total number of Marines within the field, the diversity of specialties, management functionality, and training requirements.[7]   Marines are initially screened for a specific OccFld during the recruitment process by a classification process established within the MOS Manual. Classification criteria vary according to the specific knowledge, skills, and abilities required for each OccFld.[8]   The Air Traffic Control specialty is designated within Occupational Field 72 (Air Control/Air Support/Antiair Warfare/Air Traffic Control). Within the Military Occupational Field Manual, Occupational Fields are identifiable by the first two digits of a four-digit code.  The Air Traffic Control (ATC) OccFld is coded as 7200.   Marines within this field must meet the requirements for operating and managing air command and control functions associated with the Marine aircraft wing. The qualifications for entry include manual dexterity for man-machine interface, highly developed visual/auditory skills, the ability to communicate effectively with radios, and the leadership and skills to work effectively as a member of a command and control team.[9]

Once MATC training commences, Marines are assigned a Primary Military Occupational Specialty (PMOS).  The last two digits of the four-digit code delineate a PMOS within the Occupational Field (e.g., MOS 7251, Air Traffic Control Trainee). Selection to the Air Traffic Control Trainee PMOS is predicated upon meeting the following criteria: [1] possess an ASVAB General Technical (GT) Score of 110 or higher; [2] meet the physical requirements of and pass a medical examination for a Class II physical prior to beginning the Air Traffic Control Basic Course (ACA1)[10]; [3] possess normal color vision; and [4] meet the eligibility requirements for a Secret level security clearance.[11]   These criteria establish the minimum standards required for assignment to

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[7] Ibid., vi.

[8] Ibid.

[9] Ibid., 3.566.

[10] U.S. Navy, Navy Medical Procedure P-117, *Manual of the Medical Department* (Washington, DC: U.S. Department of the Navy, 2005), 15–51.

[11] U.S. Marine Corps, *MOS Manual*, 3.568.

the 7251 PMOS; however, certain criteria can be waived, based on the operational need for qualified personnel to fill manpower vacancies.

## B.     ARMED SERVICES VOCATIONAL APTITUDE BATTERY (ASVAB)

Military service requires a certain degree of cognitive ability.  Placement of personnel within vocations commensurate to their aptitude requires a standardized assignment metric that is relatively easy to measure and apply.  To meet this goal, the Department of Defense (DoD) adopted the Armed Services Vocational Aptitude Battery (ASVAB) in 1976 for use by all military services.  The ASVAB continues to serve as an integral component for determining enlistment eligibility.

The ASVAB consists of nine subtests that are designed to measure aptitudes in the following five domains: Verbal, Math, Science, Technical, and Spatial (see Table 1).[12]  The scores from four subtests—Paragraph Comprehension (PC), Word Knowledge (WK), Arithmetic Reasoning (AR), and Mathematics Knowledge (MK)—are combined to compute an Armed Forces Qualification Test (AFQT) score used by all branches of service. The combination of scores from the PC and WK subtests is called the Verbal Expression (VE) score.  The AFQT score is calculated as follows:[13]

$$AFQT \text{ score} = 2VE + AR + MK$$

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[12] U.S. Marine Corps, Marine Corps Order (MCO) 1230.5B, *Classification Testing* (Washington, DC: U.S. Department of the Navy, 2009), 3.

[13] Office of the Secretary of Defense, "ASVAB Fact Sheet," *Official Site of the ASVAB,* last accessed 24 February 2012, http://official-asvab.com/docs/asvab_fact_ sheet.pdf

Table 1.     Armed Services Vocational Aptitude Battery Subtest Descriptions

| Subtest | Content |
|---|---|
| General Science (GS) | Knowledge of or about physical, chemical, and biological properties |
| Arithmetic Reasoning (AR) | Reasoning required to perform arithmetic processes |
| Word Knowledge (WK) | The meanings of selected words |
| Paragraph Comprehension (PC) | Understanding of written material from brief paragraphs |
| Auto and Shop Information (AS) | Knowledge of and familiarity with tools, shop practices, maintenance, and repair of automobiles |
| Mathematics Knowledge (MK) | Application of learned mathematics principles |
| Mechanical Comprehension (MC) | Understanding and application of various mechanical principles |
| Electronics Information (EI) | Identification or application of simple electrical or electronic knowledge |
| * Assembling Objects (AO) | Ability to determine how an object will look when its parts are put together |

* Note: Assembling Objects subtest is not available on all versions of the ASVAB.
Source: Office of the Secretary of Defense, "ASVAB Fact Sheet," *Official Site of the ASVAB,* last accessed 24 February 2012, http://official-asvab.com/docs/asvab_fact_ sheet.pdf

AFQT raw scores are converted to percentile scores ranging from 1 (lowest) to 99 (highest) based on norms developed through the nationwide testing of young men and women between the ages of 18 to 23 years.  Thus, an AFQT score of 50 is the mean, dividing "above-average" from "below-average."  The Marine Corps and other services use AFQT scores to group applicants by categories (I through IV).  Applicants who score in Category IV are required to obtain a waiver for Headquarters Marine Corps (HQMC) to be considered eligible.[14]  AFQT Categories are established by DoD and utilized by the Marine Corps to determine the ratio of accessions for potential recruit candidates (see

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[14] Marine Corps Studies Program Support, *Marine Air Traffic Control Training and Revocations Study*, 3.37.

Table 2).  Applicants who score in AFQT Category V (below the 21st percentile) are ineligible to enlist in the Marine Corps and other military services.[15]

Table 2.    AFQT Categories by Percentile Score Range

| AFQT Category | AFQT Percentile Score Range |
|---|---|
| I | 93–99 |
| II | 65–92 |
| IIIA | 50 - 64 |
| IIIB | 31 - 49 |
| IV | 21–30 |

Source: U.S. Marine Corps, Marine Corps Order P1100.72C, *Military Procurement Manual, Volume 2, Enlisted Procurement (Short title: MPPM ENLPROC)* (Washington, DC: U.S. Department of the Navy, 2004), 3.76.

Categorization is a useful tool for balancing individual aptitude with the requirements for specific occupations.  Higher AFQT scores essentially translate into eligibility for a wider array of occupational specialties. However, aptitude test scores alone do not qualify an applicant for enlistment.  Candidates are additionally arranged into Education Tiers (I through III) based on their educational level.  The combination of an applicant's AFQT score and Education Tier will determine enlistment eligibility as well as the person's qualifications for specific enlistment programs and bonuses (see Table 3).[16] DoD minimum standards require that, during any fiscal year, at least 60 percent of Marine recruits must test in the top half of the AFQT percentile distribution and 90 percent should be categorized as Tier 1.[17]  In fiscal year 2010, 99.7 percent of Marine recruits had a high school diploma and fell within Education Tier 1, and

[15] Ibid.

[16] U.S. Marine Corps, Marine Corps Order P1100.72C, *Military Procurement Manual, Volume 2, Enlisted Procurement (Short title: MPPM ENLPROC)* (Washington, DC: Department of the Navy, 2004), 3.76.

[17] Aline O. Quester, *Marine Corps Recruits: A Historical Look at Accessions and Bootcamp Performance* (Washington, DC: CNA, 2010), 3.

72.5 percent were in AFQT Category I–IIIA.[18]  The combination of educational Categories and Tiers provides recruitment and manpower personnel with a metric to ascertain eligibility for enlistment and meet personnel strength goals.

Table 3.     Minimum Armed Forces Qualification Test (AFQT) Percentile Score and Education Tier Required for Enlistment Eligibility in the Marine Corps, Fiscal Year 2011

| If an applicant is a: | Then the minimum AFQT score required is… | and the minimum GT score required is… (Not waiverable) |
|---|---|---|
| Tier I High School Graduate | 21 | 80 |
| Tier II Alternative Credential | 31 | 90 |
| Tier III Non-high school graduate | 50 | 90 |
| Tier I High School Senior | 21 | 80 |

Note: Applicants with an AFQT score below 31 are not authorized enlistment without an administrative review (this is not a waiver).  Source: U.S. Marine Corps, Marine Corps Order P1100.72C, *Military Procurement Manual, Volume 2, Enlisted Procurement (Short title: MPPM ENLPROC)* (Washington, DC: U.S. Department of the Navy, 2004), 3.76.

The Marine Corps additionally combines selected ASVAB subtests into four aptitude composites: Mechanical Maintenance (MM), Clerical (CL), Electrical (EL) and General Technical (GT). To compute composite scores, subtest scores are converted to standard scores with a mean of 50 and a standard deviation of 10.[19]  Standard scores are

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[18] U.S. Marine Corps, *FY 2012 Budget Estimates: Military Personnel, Marine Corps* (Washington, DC:U.S. Department of the Navy, 2011), 6.

[19] Office of the Secretary of Defense, "Understanding the ASVAB," *Official Site of the ASVAB*, last accessed 25 February 2012, http://official-asvab.com/understand_res.htm.

then converted into Marine Corps composite scores with a mean of 100 and a standard deviation of 20.[20] Composite scores are a fundamental element in screening for a particular MOS.

Each branch of service computes aptitude composite scores differently based on its own occupational requirements. The subtests used by the Marine Corps for its four aptitude composites are shown in Table 4. The MATC field focuses on the General Technical (GT) composite score. As seen in Table 4, the GT composite consists of the WK, PC, AR, and MC subtests. As previously observed, a GT score of 110 or higher is used to determine eligibility for assignment to MATC primary training; however, this score is "waiverable," based on Marine Corps manpower needs to fill personnel vacancies.[21] Of note is a discrepancy between the minimum GT score of 110 listed in the MOS Manual and a minimum GT score of 105 cited in the MATC Training and Readiness (T&R) Directive.[22] Applicants for enlistment who receive a qualifying GT score from ASVAB testing can be guaranteed acceptance into training within Occupational Field 72, Air Traffic/Air Support/Antiair Warfare/Air Traffic Control at the time they sign a contract to enlist. A new Marine recruit may alternatively agree to an open contract during enlistment and be assigned to OccFld 72 after completing recruit training.

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[20] Robert J. Schaffer III, *Relating the Armed Services Vocational Aptitude Battery to Marine Job Performance* (Master's thesis, Naval Postgraduate School, 1996), 3–5.

[21] Marine Corps Studies Program Support, *Marine Air Traffic Control Training and Revocations Study*, 3.37.

[22] U.S. Marine Corps, Navy Marine Corps Directive 3500.98, *Aviation Training and Readiness (T&R) Directive, Marine Air Traffic Control (MATC)* (Short Tiles: T&R Directive, MATC) (Washington, DC: U.S. Department of the Navy, 2006), 2.18.

Table 4.     Marine Corps Armed Services Vocational Aptitude Battery (ASVAB) Composites

| Aptitude Composite | ASVAB Subtest Components |
|---|---|
| General Technical (GT) | WK + PC + AR +MC |
| Mechanical Maintenance (MM) | AR + EI + MC + AS |
| Electrical Repair (EL) | AR + MK + EI + GS |
| Clerical/Administration (CL) | WK + PC + MK |

Source: U.S. Marine Corps, Marine Corps Order 1230.5B, *Classification Testing* (Washington, DC: U.S. Department of the Navy, 2009), 4.2.

## C.     MEDICAL REQUIREMENTS FOR MARINE CORPS AIR TRAFFIC CONTROLLERS

All potential candidates for enlistment into the U.S. Armed Forces undergo a thorough physical examination to determine their qualification for military service. Examination guidelines pertaining to all branches of service are established within Army Regulation 40-501, *Standards of Medical Fitness*.[23]  Medical assessments are conducted upon initial accession at Military Entrance Processing Stations (MEPS) where candidates are either considered qualified or unqualified for service.  The MATC requirement for normal color vision is first screened at MEPS using the Pseudomatic Plates (PIP) and the Farnsworth Lantern (FALANT) color vision tests.[24]  While possessing color vision is not a qualifying requirement for enlistment, all candidates are tested because it is a prerequisite for selection into many occupational specialties.

Once enlisted, Marine recruits report to either Marine Corps Recruit Depot (MCRD) Parris Island or San Diego for initial training.  Within the first fourteen days of

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[23] U.S. Army, Army Regulation 40-501, *Standards of Medical Fitness* (Washington, DC: U.S. Department of the Army, 2007), 1.

[24] U.S. Army, Army Regulation 601-270, *Military Entrance Processing Station (MEPS)* (Washington, DC: U.S. Department of the Army, 2011), 81.

training, recruits receive an additional limited physical examination.[25]  This additional medical testing, however, is primarily designed to ensure that individuals meet the minimal physical requirements to complete recruit training and does not focus on meeting the more stringent medical criteria established for service within aviation-related military occupational specialties.[26]

As previously stated, some enlisted candidates are contractually guaranteed OccFld 72 prior to entering recruit training (which includes the Air Traffic Controller specialty) while others enlist under an open contract option.  The open contract option allows placing individuals in a variety of fields based upon overall Marine Corps manpower requirements.  "Open contract" Marines are typically not assigned to an occupational field until after recruit training is complete.  To reduce the time and expenditure associated with the additional medical screening required for service in aviation-related fields, Marines do not receive these more stringent examinations until arriving at their first aviation-related training station.  For Marines entering MATC training, this screening is conducted at Naval Air Station (NAS) Pensacola, the location of most Marine Corps enlisted aviation training facilities.

Upon entering training at NAS Pensacola, MATC students are screened to determine whether they meet the MOS Manual requirements for a Class II military physical.  However, the U.S. Navy Manual of the Medical Department (MoMD) categorizes military Air Traffic Control as Class III personnel.[27]  A possible discrepancy exists between the MOS Manual Class II and Manual of the Medical Department Class III nomenclature.  According to the MoMD, Air Traffic Controllers are not held to Class II personnel standards.[28]

The Class III personnel medical exam is given by a naval flight surgeon.  MATC personnel must meet several criteria for Class III qualification beyond normal enlisted

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[25] U.S. Navy, Navy Medical Procedure P-117, *Manual of the Medical Department* (Washington, DC: U.S. Department of the Navy, 2005), 15.4.

[26] U.S. Marine Corps, Depot Order P1513.6B, *Recruit Training Order* (Parris Island, SC: Marine Corps Recruit Depot/Eastern Recruiting Region, 2008), 4.6.

[27] U.S. Department of the Navy, *Manual of the Medical Department*, 15.69.

[28] Ibid., 15.66.

medical standards. The most pertinent requirements for determining training eligibility include the following: [1] visual acuity correctable to 20/20 in each eye; [2] normal color vision; and [3] establishing no speech impediment by passing the Read Aloud "Banana Oil" Test.[29] Failure to meet any of these requirements results in disqualification from training. Of particular note, within the MoMD, Class III vision requirements state that depth perception is not required for medical qualification.[30]

## D. SECURITY CLEARANCE REQUIREMENTS FOR MARINE CORPS AIR TRAFFIC CONTROLLERS

Effective national defense requires that certain information remain in confidence to protect U.S. citizens and promote homeland security. Background check procedures were enacted by the U.S. Executive Branch to ensure all members in the Armed Forces who handle information sensitive to national security are screened for reliability in maintaining confidentiality and secrecy. Sensitive information may be classified at one of the following three levels: [1] Top Secret; [2] Secret; and [3] Confidential.[31]

All U.S. service members who handle classified information must undergo a personnel security investigation (PSI).[32] To maintain mobility and operational readiness, Headquarters Marine Corps (HQMC) requires all MOSs specified in the MOS Manual to have clearance eligibility established to support potential assignments.[33] The MOS Manual further specifies that potential candidates for selection into Marine Corps Air Traffic Control military occupational specialties must obtain Secret level clearance eligibility. Failure to obtain the clearance, or subsequent loss after it is granted, is grounds for revocation from all MATC MOSs.[34]

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[29] Ibid., 15.70.

[30] Ibid., 15.69.

[31] Executive Order No. 13292, *Further Amendment to Executive Order 12958, as Amended, Classified National Security Information* (2004), 2.

[32] Secretary of the Navy, SECNAV M-5510.30, *Department of the Navy Personnel Security Program* (Washington, DC: U.S. Department of the Navy, 2006), 7.10.

[33] Ibid., 7.15.

[34] U.S. Marine Corps, *MOS Manual*, 3.568 – 3.571.

### E. NON-COGNITIVE ATTRIBUTES ASSOCIATED WITH AIR TRAFFIC CONTROL

Cognition pertains to the mental processes of perception, memory, judgment, and reasoning. These skills are often measureable and therefore useful for screening and quantifying performance. The definition of non-cognitive skills, however, varies according to the social and scientific disciplines using the term. For the purpose of this study, non-cognitive skills pertain to an individual's emotional and volitional processes, such as behavior, personality, motivation, and interests. Often, non-cognitive traits are qualitative in nature making evaluation more subjective and difficult to measure; nevertheless, these attributes are identifiable and, with the proper method of quantification, can be useful tools in developing screening metrics to predict attrition and revocation.

Determination of eligibility to enter MATC OccFlds is not currently established through testing of non-cognitive traits. When ascertaining whether a Marine is eligible to become an air traffic controller, ASAB GT score, medical clearance, color vision, and eligibility for a secret security clearance are the primary determinants.[35] Marine Corps doctrine associated with air traffic control does, however, suggest that certain non-cognitive attributes are important when considering success within MATC occupational specialties. For example, the description of Occupational Field 72 within the MOS Manual states that qualification for acceptance must include the leadership and skills to work effectively as a member of a command and control team.[36] Additionally, the Marine Corps ATC Training and Evaluation Report Form establishing standards for evaluating controllers lists the following attributes as factors in determining qualification: [1] "positive control of a situation is provided: controller takes command of control situations; does not act in a hesitant and uncertain manner"; and [2] "acts decisively; appears to have confidence."[37] These factors are non-cognitive and their use for

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[35] Ibid., 3.568.

[36] Ibid., 3.566.

[37] U.S. Department of the Navy, Naval Aviation Order 00-80T-114, *NATOPS Air Traffic Control Manual* (Patuxent River, MD: The Chief of Naval Operations, 2009), J.2.

measuring qualification suggests specific personality or emotional characteristics can be important in determining success or failure within MATC occupational specialties.

The non-cognitive traits of military air traffic controllers are closely associated with those of civilian controllers working within the Federal Aviation Administration (FAA). The FAA states that the job of controlling air traffic is designed for individuals who are "motivated, decisive, committed, and self-confident."[38] Determination of these traits for selection purposes is problematic. To address the difficulty of measuring non-cognitive attributes for screening potential applicants for military occupational specialties, the Department of the Navy created the Navy Computer Adaptive Personality Scales (NCAPS).[39]

NCAPS was designed to specifically meet the challenges of determining whether service members have the personality and interest factors to succeed in certain Navy occupations. Previous personality tests were not suited for service selection due to the length of time required to take the test and the ability of test-takers to fake the personality profile believed to give the best opportunity for selection into the occupation of their choice.[40] The NCAPS test attempts to overcome these difficulties by limiting testing duration to 30 minutes and using overlapping personality questions that determine 13 traits deemed most likely for success in certain military occupations. The test administers 12 items per trait and is constructed by giving each tester two alternatives per question that bracket the middle of a personality trait score scale (on a 2–8 scale with a mean of 5 and a standard deviation of 1).[41] The answer is measured against other questions within a trait category until a "statistical criterion for high and low scorer is established" (see Table 5).[42]

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[38] Federal Aviation Administration, *How to Become an Air Traffic Control Specialist*, last accessed 02 Mar 2012, http://www.faa.gov/about/office_org/headquarters_offices/ahr/jobs_careers/occupations/atc/

[39] Amanda O. Lords, Ronald M. Bearden, Hubert Chen, and Geoffrey Fedak, *Navy Computer Adaptive Personality Scales: Initial Results* (Millington, TN: NPRT, 2006), 1.

[40] Ibid.

[41] Ibid., 3.

[42] Ibid.

Table 5.    Navy Computer Adaptive Personality Scales (NCAPS) Traits for High Scorers and Low Scorers by Factor

| Factor | High Scorer | Low Scorer |
|---|---|---|
| Achievement | Sets challenging goals; strives for excellence | Avoids challenging projects; gives up easily |
| Adaptability/Flexibility | Willing to change approach; likes variety at work | Difficulties adjusting to new situations and people |
| Attention to Detail | Exacting, precise, accurate; spots minor errors, dislikes clutter | Sloppy, imprecise; misses important details; makes carless errors; state of disarray |
| Dependability | Reliable, well organized, orderly, plans well | Unreliable, undependable, falls behind in duties, misses deadlines |
| Dutifulness/Integrity | Strong moral sense of duty and integrity | Rebellious, contemptuous; not accountable for own actions |
| Leadership Orientation | Willing to lead, take charge, offer opinions and direction, and to mobilize others; is confident, forceful, firm, and decisive | Prefers to let others assume leadership roles; is indecisive; does not enjoy being the center of attention; is submissive and readily falls into the role of "follower" |
| Perceptiveness/Depth of Thought | Interested in pursuing topics in depth and enjoys abstract thought; has a need to understand how things work; seeks to understand the "big picture" | Takes little time for reflection; is not comfortable engaging in abstract thought; has little desire to think things through in depth or to probe for new insights; takes a shortsighted, shallow view of things |
| Self-control/Impulsivity | Tends to act on the "spur of the moment;" speaks and vents emotions and engages in behaviors without thinking through possible consequences | Suppresses negative emotions and inappropriate behaviors, even in situations where it is difficult to do so; thinks before acting |
| Social Orientation | Outgoing, warm, likeable, sociable; values connections with others | Shy, reserved, aloof, prefers to be alone; creates friction when around others |
| Self Reliance | Self-sufficient, resourceful, likes to make own decisions | Relies on others to get things done; depends on others |
| Stress Tolerance | Maintains composure and thinks clearly under stress; can easily put aside worries | Becomes indecisive or makes poor decision under stress; prone to worry |
| Vigilance | Alert to environment | Experiences lapses in attention |
| Willingness to Learn | Learns from mistakes; seeks learning opportunities; takes advice | Avoids training opportunities; does not seek clarification; narrow range of interests |

Source: Amanda O. Lords, Ronald M. Bearden, Hubert Chen, & Geoffrey Fedak, *Navy Computer Adaptive Personality Scales: Initial Results* (Millington, TN: NPRST, 2006), 2.

NCAPS is a multifaceted personality/character instrument for selection and classification. It gained recognition in 2010 from the Society for Industrial and Organizational Psychology, for technological innovation of applied psychology in the workplace.[43] NCAPS has been found to be a valid predictor of on-the-job performance. Researchers with Navy Personnel Research, Studies, and Technology (NPRST) are currently conducting NCAPS validation studies for many Navy jobs and developing tailored selection systems. A subset of NCAPS is used in screening for the Navy Special Operations Sea, Air, and Land (SEAL) community. NPRST personnel are also working with the Marine Corps conducting NCAPS validation studies for air traffic controllers and the Intelligence Community.[44]

## F.   CAREER PROGRESSION OPPORTUNITIES FOR MARINE CORPS AIR TRAFFIC CONTROLLERS

### 1.   The Marine Corps Air Traffic Control Basic Course

The Marine Corps Air Traffic Control Basic Course (ACA1) is located at Naval Air Technical Training Center (NATTC) in Pensacola, Florida, and serves as the primary schooling facility for both Navy and Marine Corps officer and enlisted ATC personnel. Enlisted training comprises a four-month course with 29 scheduled events designated as core introduction training.[45] During this period of instruction, Marines are provided entry-level instruction on ATC concepts, regulations, procedures, and operating techniques. Upon completion of training, graduates possess the same certification obtained by FAA controllers graduating from the National FAA Air Traffic Control School.[46]

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[43] Ibid.

[44] K.M. Walker, W.L. Farmer, and R.C. Roberts, *Suitability Screening Test for Marine Corps Air Traffic Controllers Technical Report* (manuscript in preparation, NPRST, 2012).

[45] U.S. Marine Corps, Navy Marine Corps Directive 3500.98, *Aviation Training and Readiness (T&R) Directive, Marine Air Traffic Control (MATC) (Short Tiles: T&R Directive, MATC)* (Washington, DC: U.S. Department of the Navy, 2006), 2.14.

[46] Ibid., 2.17.

## 2. MOS Descriptions and Prerequisites

The Marine Corps Air Traffic Control T&R Manual states the mission of MATC personnel is to provide all weather radar/non-radar approach, arrival, departure, enroute, and tower MATC services in support of Forward Operating Bases, Marine Air Ground Task Forces (MAGTF), and joint and coalition operations by integration within the Marine Air Command and Control System (MACCS), Integrated Air Defense Systems (IADS), and Single Integrated Air Picture (SIAP).[47] The Mission Essential Tasks (METs) required of all MATC personnel are the following: [1] deploy and conduct maneuver; [2] disseminate tactical warning information and attack assessment; [3] conduct air missile defense operations; [4] conduct air-to-air operations; [5] establish, operate, and maintain baseline information exchange; [6] conduct rear area security; and [7] provide for combat identification.[48] These skills provide the foundation for MOS designation and career progression for all MATC MOSs.

### a. MOS 7251, Air Traffic Control Trainee

Marines receive this MOS upon entering the NATTC ACA1 course. The primary role of personnel in this MOS is to undergo instruction in pursuant of qualifications for Air Traffic Control designation, MOS 7257. Prerequisites include the following: [1] must possess a GT score of 110 or higher; [2] must meet the physical requirement of and pass a medical examination per NAVMED P-117, chapter 15, article 65, paragraph 7(W) before beginning the Air Traffic Control Basic Course (ACA1); [3] must possess normal color vision; and [4] must pass security requirement: Secret security clearance eligibility. Requirements for designation include completion of the Airman Written Test (AWT), Air Traffic Control Basic Course (ACA1), and receive an Air Traffic Control Specialist (ATCS) certificate.[49]

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[47] Ibid., 2.3.

[48] Ibid., 2.4.

[49] U.S. Marine Corps, *MOS Manual*, 3.568.

### b.      MOS 7252, Air Traffic Controller-Tower

Marines with this MOS designation perform various duties within a control tower at an established air traffic control facility, expeditionary airfield, or remote landing area relating to the control of friendly aircraft.  Tower controllers ensure aircraft operate within assigned airspace and maintaining visual surveillance of the terminal control area and other movement areas.  Additional duties include formulating clearances and directing aircraft and vehicular traffic operating on runways, landing areas, and taxiways. Prerequisites include qualification in the MOS 7257 (Air Traffic Controller) and Secret security clearance eligibility. The requirement for designation is qualification as a local controller by issuance of an FAA Control Tower Operator (CTO) license or Commanding Officer (CO) approval after serving at least four months as a local controller in an expeditionary/tactical field environment.[50]

### c.      MOS 7253, Air Traffic Controller-Radar Arrival/Departure Controller

Marines with this MOS designation perform various duties within a radar facility relating to the control of air traffic at an established air traffic control facility, expeditionary airfield, or remote landing areas.   They coordinate aircraft movement information with associated facilities or agencies, coordinate current weather and airfield conditions as required, and perform air traffic control duties in both tactical and nontactical air traffic control organizations.  Prerequisites include qualification in the MOS 7257 (Air Traffic Controller) and Secret security clearance eligibility.   The requirement for designation is qualification as a radar arrival/departure controller or CO approval after serving at least four months as a local controller in an expeditionary/tactical field environment.[51]

### d.      MOS 7254, Air Traffic Controller-Radar Approach Controller

Marines with this MOS designation perform duties within a radar facility relating to the control of aircraft at an established air traffic control or expeditionary

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[50] Ibid., 3.569.

[51] Ibid.

airfield. They provide radar surveillance of approach control airspace and coordinate with aircraft passing through the terminal control area. Prerequisites include qualification in the MOS 7257 (Air Traffic Controller) and Secret security clearance eligibility. The requirement for designation is qualification as a radar approach controller or CO approval after serving at least four months as a local controller in an expeditionary/tactical field environment.[52]

### e. MOS 7257, Air Traffic Controller

Marines with this MOS designation perform various duties and tasks relating to the control of air traffic and vehicles within designated areas at an established airport control zone, expeditionary airfield, or remote landing site. These duties are performed within control towers, radar facilities, and expeditionary air traffic control equipment. Prerequisites include the following: [1] secret security clearance eligibility or temporary Security Compartment Information (SCI) clearance; and [2] must possess control tower position qualifications on ground control and tower flight data, or must possess radar position qualifications on radar final control and radar flight data/coordinator at a Marine Corps Air Station (MCAS) or Marine Corps Air Facility (MCAF). Requirements for designation include completion of the Airman Written Test (AWT), Air Traffic Control Basic Course (ACA1), and receive an Air Traffic Control Specialist (ATCS) certificate.[53]

### f. MOS 7277, Weapons and Tactics Instructor-Air Control

Marines with this MOS designation provide weapons and tactics instruction to aviation personnel on aviation ground equipment/weapons systems for operations in a total threat environment in coordination with ground and other aviation units. Within the Air Traffic Control occupational specialty, this MOS is only available to qualified air traffic control personnel with either a MOS designation of 7257 (Air Traffic Controller) or 7291 (Senior Air Traffic Controller). Requirement for designation

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[52] Ibid,. 3.570.

[53] Ibid., 3.571.

is the completion of the Marine Aviation Weapons and Tactics Squadron Weapons and Tactics Instructor Course at MCAS Yuma, AZ.[54]

### g.      MOS 7291, Senior Air Traffic Controller

Marines with this MOS designation assist and advise the air traffic control detachment commander, Marine Air Control Squadron (MACS) operations officer, or the air station air traffic control facility officer.  The senior air traffic controller supervises and instructs air traffic controllers, providing information concerning the safe, accurate, and efficient application of air traffic control procedures.  Prerequisites and requirements include the following: [1] must possess the PMOS 7257 and Necessary Military Occupational Specialty (NMOS) 7252, 7253, and 7254, or possession of a waiver from obtaining all three NMOS by HQMC, and [2] Secret security clearance eligibility.[55]

### 3.      MOS Skill Designations for Marine Air Traffic Controllers

MATC career progression is predicated upon the standards established in MARADMIN 230/04.  This administrative message released in 2004 provides the specific time periods required for MOS designations and appropriate qualifications.  The standards for progression are as follows: [1] MOS 7257 shall be achieved by Marines within the first 9-months of arriving at their first ATC facility or they will be processed for MOS revocation and reassignment to another occupational field; [2] within 3 years of graduation from ACA1 school, Marines shall achieve the following MOS combinations: [a] 7257/7252, or [b] 7257/7253, or [c] 7257/7254.  Marines who do not meet this requirement will be processed for MOS revocation and reassignment to another occupational field; [3] all Marine air traffic controllers should obtain two of the following MOS skill designations: 7252, 7253, or 7254 within six (6) years of graduation from ACA1 school; [4] all Marine air traffic controllers shall obtain two of the following MOS skill designations: 7252, 7253, or 7254 within nine (9) years of graduation from ACA1 school or they will be processed for MOS revocation and reassignment to another

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[54] Ibid.

[55] Ibid., 3.572.

occupational field; and [5] all Marine air traffic controllers shall obtain all three of the following MOS skill designations: 7252, 7253, and 7254 within twelve (12) years of graduation from ACA1 school or they will be processed for MOS revocation and reassignment to another occupational field. Waivers to these qualifications are available but must be submitted to HQMC via a naval letter endorsed by the Marine's chain of command.[56]

## G.  CHAPTER SUMMARY

Selection and retention within Marine Air Traffic Control specialties requires information and processing from a variety of sources. The Marine Occupational System provides the framework for selecting candidates with the highest potential to successfully complete the prerequisites required for MOS designation. The ASVAB is the primary determinant of cognitive ability required for military service and the scores obtained serve as a useful metric to place individuals in occupations commensurate with the skills and knowledge required for specific specialties. Medical clearance and security eligibility are also important factors in determining whether a Marine is qualified for a particular MOS. For MATC personnel, several specialties exist for career progression, and guidelines for qualification aid in ensuring that training is consistently and appropriately maintained.

Combined, this information provides the basis for understanding how MATC personnel are selected, trained, and progress through their careers. These factors are important for understanding how personnel attrition and revocation affect MATC personnel and, in a larger context, the Marine Corps manpower system. The next chapter examines several of the most relevant studies concerning the validity of methods currently used to screen potential MATC personnel. These studies are useful in helping to ascertain whether current selection and assignment standards are valid predictors of success and, if not, whether additional methods might be utilized to improve predictability.

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[56] U.S. Marine Corps, *MOS Skill Designations for Marine Air Traffic Controllers* (2004).

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# III. LITERATURE REVIEW

## A. INTRODUCTION

Validation of the current Marine Corps Air Traffic Control (MATC) selection process is problematic. While numerous studies indicate that the Armed Services Vocational Aptitude Battery (ASVAB) is a valid predictor of the cognitive abilities required for military service, literature is scarce concerning how successful Marine Corps General Technical (GT) scores are at predicting success within the MATC Basic Course. Additionally, measurement of cognitive ability is only one facet of the multi-layered process for selecting and retaining MATC personnel. Studies indicate that attrition and revocation are also largely affected by medical disqualifications, non-cognitive attributes, and, less directly, the loss of security clearance eligibility.

Building upon previous research, this study examines the effectiveness of current MATC selection criteria in predicting personnel attrition and revocation within all MATC Military Occupational Specialties (MOSs). Given that a majority of personnel losses occur during training at the Air Traffic Control Basic Course, particular emphasis focuses on determining successful completion of this stage of training. This chapter examines the effects of personnel attrition and revocation on the Marine Corps and MATC specialties, validation of ASVAB screening procedures, the impact of medical disqualifications on Marine Corps and MATC attrition and revocation, and substantiation of NCAPS testing as a useful non-cognitive screening tool.

## B. THE EFFECTS OF PERSONNEL ATTRITION AND REVOCATION ON THE MARINE CORPS AND MATC SPECIALTIES

The negative effect of personnel attrition on military preparedness continues to concern all branches of the Armed Forces. Several studies have recommended procedural changes within the Department of Defense to lower attrition rates by streamlining recruiting techniques and incentives, updating screening practices, and increasing potential recruits' awareness of the challenges associated with military

service.[57]   Some of these recommendations have the potential to aid in lowering personnel attrition and revocation rates within the Marine Corps and, more specifically, MATC specialties.

Several U.S. General Accounting Office (GAO) studies were conducted in 1997 and 1998 to determine what changes to DoD recruiting, screening, and training might aid in reducing military attrition.  During the 1990s, nearly one-third of the personnel who enlisted in the Armed Forces failed to complete their initial enlistment contracts and were discharged prematurely from service.[58]  This phenomenon is called "first-term attrition" in military manpower research.  It is generally examined by following an annual cohort of recruits through their first 36–48 months (depending on the particular study) of contracted service.  A 1989–1993 study of Marine Corps enlistees who were separated during their first terms ranged from a low of 32.5 percent to a high of 38.1 percent.[59]  A 2010 study indicates that first-term attrition dropped from 33.5 percent in FY 1995 to 24.8 percent in FY 2005.[60] These data suggest that first-term attrition within the Marine Corps is declining, but it still represents a considerable sunk cost with the loss of nearly a quarter of all first-term Marines annually.

According to DoD and all branches of services, the most important, single variable in predicting the likelihood of first-term attrition is a recruit's educational attainment.[61]  Enlistees with a high school diploma have historically experienced a first-term attrition rate that is one-half that of their counterparts who have no diploma.  A secondary determinant is a recruit's Armed Forces Qualification Test (AFQT) score; enlistees who score in the upper 50th percentile have historically had lower attrition rates than have those who score in the lower 50th percentile.[62]  A 2010 report published by the

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[57] U.S. General Accounting Office, GAO/NSIAD-97-39, *Military Attrition: DOD Could Save Millions by Better Screening Enlisted Personnel* (Washington, DC: General Accounting Office, 1997), 10.

[58] Ibid.

[59] Ibid., 11.

[60] Quester, *Marine Corps Recruits: A Historical Look at Accessions and Bootcamp Performance*, 40.

[61] U.S. General Accounting Office, *Military Attrition: DOD Could Save Millions by Better Screening Enlisted Personnel*, 13.

[62] Ibid.

Center for Naval Analyses (CNA) validates these findings for the Marine Corps.[63]  In an analysis of Marine Corps recruit training, the study found that recruits in Education Tier I with AFQT scores at or above the 50th percentile, the so-termed "high-quality recruits," experience lower attrition rates than enlistees below this threshold (with a difference of 2.1 percentage points for men and 2.4 percentage points for women over 48 months of service).[64]

A 1997 GAO study concerning military attrition cautions DoD against screening recruits based primarily on obtaining a high school diploma and scoring in the upper 50th percentile on the AFQT.[65]  The study suggests that applying these two metrics is limited. Since 1983, over 90 percent of DoD recruits have possessed a high school diploma, and the percentage of recruits scoring above-average on the AFQT has remained at 58 percent or higher.[66]  Since the early 1990s, the Marine Corps has exceeded these benchmarks, with 95 percent having Tier I education and nearly 65 percent of non-prior service recruits possessing an AFQT score in the top half of the percentile distribution.[67]  Across all of DoD, however, attrition remained near 30 percent during this entire time period.[68] The study suggests a better method for reducing attrition could be achieved by enforcing recruiter accountability for enlisting recruits they know have preexisting disqualifying conditions and creating additional screening metrics that address shortfalls in medical screening, such as recruits' physical fitness prior to attending basic training and enlistees' willingness to train.[69]

According to the FY 2012 Department of the Navy budget estimates for Marine Corps personnel, the FY 2010 Marine Corps total force strength was 182,147

[63] Quester, *Marine Corps Recruits: A Historical Look at Accessions and Bootcamp Performance*, 3.

[64] U.S. General Accounting Office, *Military Attrition: DOD Could Save Millions by Better Screening Enlisted Personnel*, 13.

[65] Ibid., 50.

[66] Ibid.

[67] Ibid.

[68] Ibid., 60.

[69] Ibid.

personnel.[70]  Of this total, 28,053 individuals were non-prior service enlistments and 8,711 attrited from service for adverse causes and other reasons.[71]  These figures indicate that 4.8 percent of the total force attrited active duty service prior to fulfilling their enlistment contracts.

A 2006 Blue Ribbon Commission study indicated the average cost of enlisted basic training for each Marine in 2003 was $14,493.[72]  Estimating the cost incurred from MATC personnel attrition and revocation is problematic due to the varying costs for each Marine's recruitment, training, travel, housing, and career progression.  Clearly, any reduction in personnel attrition and revocation represents an economic advantage to the Marine Corps by decreasing sunk costs and avoiding replacement costs.

Analysis of data for military air traffic controllers from FYs1989–1993 indicates that, historically, MATC personnel have had the lowest attrition rate of all branches of service (see Table 6).  The lower attrition rate for MATC personnel may result from the lower number of enlistees when compared to the other services and the ability of MATC instructors to provide personalized attention for Marine trainees.

Table 6.    Military Air Traffic Controller Attrition Percentages (FYs 1989–1993)

| Branch of Service | Number of enlistees entering in FYs 1989-1993 | Number who separated from service before end of first enlistment | Attrition Rate (percent) |
|---|---|---|---|
| Army | 1,551 | 468 | 30.2 |
| Navy | 10,888 | 2,315 | 21.3 |
| Air Force | 2,596 | 533 | 20.5 |
| Marine Corps | 949 | 123 | 13.0 |

Source: U.S. General Accounting Office, *Military Attrition: Better Data, Coupled With Policy Changes, Could Help the Service Reduce Early Separations* (Washington, DC: General Accounting Office,1998), 64-70.

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[70] U.S. Marine Corps, *FY 2012 Budget Estimates: Military Personnel, Marine Corps*, 12.

[71] Ibid.

[72] Frank J. Barrett et al., *Financial Analysis of "Don't Ask, Don't Tell": How much does the gay ban cost?* (Santa Barbara, CA: Blue Ribbon Commission, 2006), 13.

Data collected from FY 1989–1993 also indicate that among the specialties comprising Marine Corps OccFld 72 (Air Control/Air Support/Antiair Warfare/Air Traffic Control), the air traffic control specialty has the lowest percentage of attrition (see Table 7). While these data indicate MATC personnel attrition may not pose as a large a concern when compared with that in other branches of service, or other OccFld 72 specialties, it is prudent to consider that trends may have changed over the past twenty years.

Table 7. Marine Corps Occupational Field 72 Attrition Percentages
(FYs 1989–1993)

| Primary Occupation | Number of enlistees entering in FYs 1989-1993 | Number who separated from service before end of first enlistment | Attrition Rate (percent) |
|---|---|---|---|
| Artillery/Gunnery, Rockets, & Missiles (Antiair Warfare) | 4,174 | 861 | 20.6 |
| Missile Guidance, Control & Checkout (Air Control/Air Support) | 1,362 | 211 | 15.5 |
| Radar & Air Traffic Control | 949 | 123 | 13.0 |

Source: U.S. General Accounting Office, *Military Attrition: Better Data, Coupled With Policy Changes, Could Help the Service Reduce Early Separations* (Washington, DC: General Accounting Office, 1998), 64–70.
Note: Artillery/Gunnery, Rockets, & Missiles includes MOSs outside the Antiair Warfare specialty which could skew attrition percentages for this field.

## C. VALIDATION OF ASVAB SCREENING PROCEDURES

The ASVAB is the primary tool for cognitive screening within the military. Validation for Marine Corps use normally occurs every 5 to 10 years, if a complaint arises from operational forces, or when new ASVAB subtests are introduced.[73] To further substantiate the ASVAB as a selection tool for the Marine Corps, researchers at

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[73] William H. Sims and Catherine M. Hiatt, *Marine Corps Selection and Classification* (Alexandria, VA: CNA, 2001), 3.

CNA developed job performance tests for three Marine Corps MOSs: Ground Radio Repair, Automotive Mechanic, and Infantry Rifleman.[74]  These MOSs provide a high-to-low range of technical skills that successfully correlate job performance with ASVAB scores. A 1990 CNA study addressed whether the GT composite score was a valid predictor of success for selection in Marine Corps MOSs.[75]  The findings of this study indicate that the GT composite qualifies most applicants for Marine Corps service. Additionally, the other composite scores (EL, CL, and MM) only increase the total applicant pool by 2 percent.[76]  Because individual MOSs have more stringent requirements for using the EL, CL, and MM composite scores, the study recommended using the GT score for initial Marine Corps selection.[77]

A 1998 GAO study analyzing attrition in FY1993 indicates that Marine Corps attrition rates within the first 48 months of a first-term enlistment continued to lower as an individual's education level increased (see Table 8).[78]  Similarly, Marine Corps attrition rates within the first 48 months of a first-term enlistment decreased as enlistees scored progressively higher on the AFQT (see Table 9).[79]  Both of these findings suggest that the ASVAB is a valid predictor of attrition for first-term Marines.

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[74] Milton H. Maier and Catherine M. Hiatt, *On the Content and Measurement Validity of Hands-on Job Performance Tests* (Alexandria, VA: CNA, 1985), i.

[75] Neil B. Carey, *Effect of the GT Composite Requirement on Qualification Rate* (Alexandria, VA: CNA, 1990), v.

[76] Ibid.
[77] Ibid.

[78] U.S. General Accounting Office, *Military Attrition: Better Data, Coupled With Policy Changes, Could Help the Service Reduce Early Separations* (Sep 1998), 50.

[79] Ibid.

Table 8.      Attrition Rate Decrease for Higher Levels of Education

| Education Level | FY 1993 Attrition Rate (percent) |
|---|---|
| High School Diploma (HSD) | 31.1 |
| 3-4 years of high school: no HSD or GED | 38.0 |
| Alternate Education Credential (Home Study Diploma) | 38.6 |
| GED only | 51.5 |

Source: U.S. General Accounting Office, *Military Attrition: Better Data, Coupled With Policy Changes, Could Help the Service Reduce Early Separations* (Washington, DC: General Accounting Office, 1998), 50.

Table 9.      Attrition Rate Decrease for Higher AFQT Scores

| AFQT Category | AFQT Score | FY 1993 Attrition Rate (percent) |
|---|---|---|
| I | 93 - 99 | 22.6 |
| II | 65 - 92 | 28.5 |
| IIIA | 50 - 64 | 32.3 |
| IIIB | 31 - 49 | 35.1 |

Source: U.S. General Accounting Office, *Military Attrition: Better Data, Coupled With Policy Changes, Could Help the Service Reduce Early Separations* (Washington, DC: General Accounting Office, 1998), 50.

A 2011 study on MATC revocation found that Marine air traffic controllers revoked from a MCAS/MCAF location from 1994-2010 scored, on average, 0.4 percentile points lower on the AFQT and 0.3 percentile points lower on the GT composite score than did controllers who were not revoked.[80]  The differences in scores were not statistically significant.  Furthermore, Marine air traffic controllers revoked

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[80] Marine Corps Studies Program Support, *Marine Air Traffic Control Training and Revocations Study*, 3.38.

from an MCAS/MCAF location for performance based reasons scored, on average, 1.0 percentile points lower on the AFQT and 1.4 percentile points lower on the GT composite score than controllers who were not revoked.[81] These differences in scores were also not statistically significant. During the same period, however, analysis of attrition from the MATC Basic Course revealed that Marines who failed the course scored, on average, 4.1 percentile points lower on the GT than did Marines who graduated and were later revoked at a MCAS/MCAF location, a statistically significant result.[82] Additionally, Marines who attrited during the MATC Basic Course, on average, scored 5.4 percentile points lower on the GT than did Marines who graduated from the course, also a statistically significant result.[83]

The Marine Corps is not the only service studying methods for reducing air traffic control attrition. A 2012 RAND report revealed steps the Air Force is taking to increase the success rate of students within their ATC training pipeline by validating ASVAB testing.[84] Due to the similarities in ATC training between all branches of service, the study is a useful tool in providing recommendations for reducing MATC attrition rates. Air Force ATC instruction comprises 72 training days at an average cost per graduate of $39,000.[85] A logistical regression was conducted using 1,944 airmen who enrolled in the ATC training pipeline between 2002 and 2007. The results indicated that each one-point increase in the ASVAB arithmetic reasoning (AR) or mathematics knowledge (MK) scores increased success by 0.5 and 1.1 percent, respectively. An increase in the ASVAB electronics information (EI) score resulted in a 0.5 percent decrease in success.[86]

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[81] Ibid.

[82] Ibid.

[83] Ibid.

[84] Thomas Manacapilli et al., *Reducing Attrition in Selected Air Force Training Pipelines* (Santa Monica, CA: RAND, 2012), 11.

[85] Ibid.

[86] Ibid., 103.

A 2006 report released by the U.S. Army Research Institute for the Behavioral and Social Sciences studied the attrition of Army air traffic controllers.[87] Using a sample of 663 soldiers who attended the Army ATC basic course from 2001 to 2004, the study found that 30.6 percent failed to complete training for academic reasons. A binary regression model revealed that ATC trainees with a higher score on the ST composite, an Army ASVAB screening composite similar in use to the Marine Corps GT composite, increased a soldier's odds of passing ATC training.[88] Education tiers also correlated with failure rates. Tier I trainees, for example, were less likely to fail than were trainees in Tier II or Tier III.[89]

A 2007 study of methods to improve military air traffic controller selection as measured by training performance indicated the ASVAB is a good predictor of several training criteria, to include final school grades and attrition from entry-level training courses.[90] The percentage of academic training failures for enlisted Air Force air traffic controllers decreased as the ASVAB GT score increased.[91] [92] Validation study results indicate that the ASVAB demonstrated acceptable validity against several USAF enlisted air traffic control training criteria.[93]

## D.    THE IMPACT OF MEDICAL DISQUALIFICATIONS ON MARINE CORPS AND MATC PERSONNEL ATTRITION AND REVOCATION

In FY1994, separations for medical conditions and failure to meet minimum behavioral or performance standards accounted for nearly 55 percent of all DoD 6-month

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[87] Eric S. Williams and Peter M. Greenston, *Pilot Study to Examine Training Eligibility Standards* (Arlington, VA: United States Army Research Institute for the Behavioral and Social Sciences, 2006), 64.

[88] Ibid.

[89] Ibid., 67.

[90] Thomas R. Carretta and Raymond E King, *Improved Military Air Traffic Controller Selection Methods as Measured by Subsequent Training Performance* (Alexandria, VA: Aerospace Medical Association, 2007), 36.

[91] Ibid., 39.

[92] All branches of military compute ASVAB GT scores differently. The Air Force formula for the GT score is the following: Verbal Expression (VE) + Arithmetic Reasoning (AR). VE = PC + WK.

[93] Ibid., 41.

enlisted attritions.[94]   Among all military services, the Marine Corps had the highest proportion of medical attrition at 34.2 percent.[95]   Marine Corps leaders suggested that the reason for the higher Marine Corps rate was due to the higher degree of physicality related to basic training and the service's larger number of ground combat MOSs.[96] Several factors were cited for this relatively high DoD attrition rate, including recruiters lacking sufficient incentives to screen personnel who were not fully qualified to complete basic training and failure by medical personnel at MEPS to properly screen enlistees for disqualifying medical conditions.[97]

Of particular interest to this study is the failure of MEPS screeners to identify personnel with disqualifying medical conditions.  The reasons cited for this discrepancy are applicants concealing their medical histories and the services waiving medical conditions that, according to DoD directives, should be disqualifying.[98] Several cases were identified of recruits passing the MEPS visual and auditory screening criteria only to be disqualified once rescreened by identical testing at basic training.[99]  This finding is consistent with results reported in the 2011 study of MATC training and revocations, which indicate that 29 percent of nonacademic attrition from the MATC Basic Course from fiscal years (FYs) 2008–2011 was for eyesight not correctable to 20/20. During the same time period, 17 percent of nonacademic attrition was attributed to other medical conditions (including conditions such as asthma and cardiac anomalies that likely existed prior to completion of MEPS induction).[100]

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[94] U.S. General Accounting Office, *Military Attrition: DOD Could Save Millions by Better Screening Enlisted Personnel*, 3.

[95] Ibid.

[96] U.S. General Accounting Office, *Military Attrition: Better Data, Coupled With Policy Changes, Could Help the Service Reduce Early Separations*, 6.

[97] U.S. General Accounting Office Report, *Military Attrition: DOD Could Save Millions by Better Screening Enlisted Personnel*, 29–33.

[98] Ibid., 33.

[99] Ibid.

[100] Marine Corps Studies Program Support, *Marine Air Traffic Control Training and Revocations Study*, 3.7.

## E. SUBSTANTIATION OF NCAPS AS A USEFUL NON-COGNITIVE SCREENING TOOL

As previously observed, the Marine Corps does not currently screen for non-cognitive traits, such as behavior, personality, motivation, and interests during screening for MOSs. The reason for not doing so is mainly due to the length of time required to administer non-cognitive instruments, the subjectivity of the results, and the likelihood that applicants will fake answers to increase their chances of being accepted. However, studies have found that the use of non-cognitive factors can enhance predictability of continuation and performance for civilian and military occupations.[101] In 2003, the Navy began research into creating NCAPS, an adaptable, reliable, Web-based test that measures many of the non-cognitive measures associated with military service and minimizes fakability.[102]

A 2006 study of NCAPS shows that it takes most participants less than 30 minutes to complete the instrument.[103] Several studies have proven substantial construct validity for NCAPS when correlated against traditional personality measures, resistance to faking and socially desirable responding, and limited statistical overlap with the ASVAB.[104] [105]–The NCAPS is currently used by the Navy to select candidates for Basic Underwater Demolition/SEAL (BUD/S) training.[106] Used with other scoring criteria, the NCAPS has decreased BUD/S training attrition from approximately 80 percent to 65 percent.[107]

Subject matter experts (SMEs) and several developmental psychologists with NPRST established levels of relevance between naval military specialties and the 13 non-

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[101] Lords, Bearden, Chen, and Fedak, *Navy Computer Adaptive Personality Scales: Initial Results*, 1.

[102] Ibid., 3.

[103] Ibid.

[104] Ibid., 5.

[105] Rosemary A. Schultz, David L. Alderton, and Andrea B. Hyneman, *Individual Differences and Learning Performance in Computer-based Training* (Millington, TN: NPRST, 2006), B.1.

[106] Marine Corps Studies Program Support, *Marine Air Traffic Control Training and Revocations Study*, ES.10.

[107] Ibid.

cognitive personality and interest constructs measured by NCAPS.[108]    From these constructs, the traits identified as most relevant to Navy air traffic controllers were (in order of most-to-least importance) attention to detail, stress tolerance, vigilance, dependability, self-control, achievement, self-reliance, and dutifulness/integrity.[109]   A 2011 MATC attrition and revocation study recommended 40 cognitive and non-cognitive attributes for success within the air traffic control field.[110]   These attributes were compiled through surveys, interviews with SMEs and MATC personnel, and a thorough literature review of military and FAA source material.  All of the traits identified by the NCAPS as relevant to Navy air traffic controllers correlate with the attributes identified by the MATC study, suggesting the NCAPS could aid as a valid non-cognitive predictor for potential MATC personnel attrition and revocation.

## F.    METHODOLOGY, RESULTS, AND CONCLUSIONS OF SIMILAR STUDIES

For this study, determination of attrition and revocation trends for MATC personnel through statistical analysis is restricted to the data available from the Total Force Data Warehouse (TFDW) and Headquarter Marine Corps, Expeditionary Enablers Branch, Command and Control Group-25 (APX-25).  While medical disqualification and non-cognitive factors are important factors in determining attrition and revocation, the Marine Corps does not currently track these characteristics for empirical study. Additionally, a 2011 MATC study by Northrop Grumman found security clearances as statistically insignificant and, consequently, they are not addressed in detail for the statistical analysis portion of this study.[111]

Studies are periodically conducted to validate the use of ASVAB scoring for predicting the success of job performance.  The largest determinant of personnel attrition

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[108] Naval Personnel Research, Studies, and Technology Division, *Development of the Navy Computer Adaptive Personality Scales Development of the Navy Computer Adaptive Personality Scales (NCAPS)* (Millington, TN: NPRST, 2006), B.1.

[109] Ibid.

[110] Marine Corps Studies Program Support, *Marine Air Traffic Control Training and Revocations Study*, 4.9.

[111] Ibid., 3.23.

and revocation within the MATC Basic Course relates to academics. From 2008 to 2011, 20 percent of the Marines who enrolled were dropped from training for academic reasons.[112] From 1994 to 2010, failure to qualify and unsatisfactory performance, both areas closely associated with cognitive ability, accounted for 60.2 percent of total MATC revocation.[113] The GT composite score remains the sole cognitive predictor for selection into the MATC field. Because of the high level of academic losses, the question arises whether the GT score alone is a valid predictor of success.

Several studies have attempted to ascertain whether different metrics of ASVAB subtests and composite scores might increase success levels in Marine Corps training. In 1996, Robert J. Schaffer III studied the validity of ASVAB subtest scores in Marine Corps initial MOS training schools.[114] In 2005, Catherine M. Hiatt conducted an ASVAB validation study for the predictive quality of the EL composite score in the Field Radio Operator MOS.[115]–In 2011, Leonard J. Rautio examined the relationship between ASVAB composite scores and success in Marine Corps Communication Schools.[116] The methodology, results, and conclusions of these studies are useful in proposing similar quantifiable metrics for decreasing personnel attrition and revocation within the MATC community.

### 1. Relating the Armed Services Vocational Aptitude Battery to Marine Job Performance

The 1996 study conducted by Robert J. Schaffer III analyzed the relationship between ASVAB scores and performance at initial Marine Corps training courses. Fifty-four separate courses were examined and eight chosen for statistical analysis based on composite score requirements. Each of the ASVAB composite scores (GT, EL, CL, and

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[112] Ibid., 3.7.

[113] Ibid., 3.15.

[114] Schaffer, *Relating the Armed Services Vocational Aptitude Battery to Marine Job Performance*.

[115] Catherine M. Hiatt, *The Relationship between ASVAB and Training School Performance for USMC Field Radio Operators* (Alexandria, VA: CNA, 2005).

[116] Leonard J. Rautio, *Study of the Standards Used to Screen Recruits for Assignment to the Communications Field in the U.S. Marine Corps* (Master's thesis, Naval Postgraduate School, 2011).

MM) was represented by two of the eight MOSs.[117] For each individual in the sample, Schaffer collected information on the final course completion date, armed forces active duty base date, completion of training, attrition, composite scores, and ASVAB composite scores. Factors that might affect attrition or completion of initial training, such as ability, demographics, and behavior, were not analyzed.

The criterion measure for determining predictive validity coefficients was Final Course Grades (FCGs). The study indicated that little variance existed in FCGs, primarily due to instructional techniques. Schaffer addressed this concern by combining FCGs with a completion variable that reports how individuals completed the course (see Table 10).[118] FCGs were then adjusted based on this coding for simpler interpretation. FCGs were only changed if an observation was for a graduate (ATTRITE = 0) with a Completion Code of 2 (academic recycle) or if the observation was for an individual who attrited from the course (ATTRITE = 1) with a Completion Code of 2 (non-academic reasons). Minimum passing grades were provided to individuals who graduated and academically recycled, or if they attrited for nonacademic reasons.[119]

Table 10.    Schaffer's Completion Code Variables

|  | If ATTRITE = 0 (a graduate) then the individual is a (an) | If ATTRITE = 1 (attrited from course) then the individual is a (an) |
|---|---|---|
| **COMPLETION CODE 1** | Regular pass | Academic attrite |
| **COMPLETION CODE 2** | Academic recycle | Nonacademic attrite |
| **COMPLETION CODE 3** | Nonacademic recycle | Not Applicable |

Source: Robert J. Schaffer III, *Relating the Armed Services Vocational Aptitude Battery to Marine Job Performance* (Master's thesis, Naval Postgraduate School, 1996), 9.

Schaffer used an adjusted validity coefficient formula where the explicit variables refer to ASVAB composite scores and the indirect variables to adjusted FCGs

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[117] Schaffer, *Relating the Armed Services Vocational Aptitude Battery to Marine Job Performance*, 6–7.

[118] Ibid., 9.

[119] Ibid.

(see Table 11).[120] This method was chosen because the population validity coefficient is underestimated when individuals are restricted from taking courses because of their ASVAB scores. The validity coefficient was reduced when individuals were removed who do not meet the minimum requirements for MOS selection.

Two methods were used for statistical analyses. In the first method, a linear multiple discriminant analysis identified groups by ASVAB scores. Individuals were assigned courses based on their highest score. The scoring requirements for many MOSs were similar. Individuals who qualify for a variety of MOSs could therefore be successful in more than one MOS. Additionally, Marine Corps composite scores contain areas from each subject allowing different combinations from the same nine subject area tests. Individual preferences and Marine Corps manpower requirements were considered in this formulation.[121] In the second method, a discriminant analysis formula was used where individual preferences and manpower requirements were not considered (see Table 12).[122]

Table 11.    Schaffer's Adjusted Validity Coefficient Formula

$$R_{XT} = \sqrt{1 - \left(1 - r_{xy}^2\right)\frac{s_y^2}{S_Y^2}},$$

| Variable | Definition |
|---|---|
| $x$ | Sample explicit variable from the selected group |
| $y$ | Sample indirect variable from the selected group |
| $X$ | Corrected for range restriction explicit variable |
| $Y$ | Corrected for range restriction indirect variable |
| $r_{xy}$ | Sample correlation between $x$ and $y$ |
| $s_y^2$ | Variance of sample $y$ |
| $S_y^2$ | Variance of reference population $Y$ |

Source: Robert J. Schaffer III, *Relating the Armed Services Vocational Aptitude Battery to Marine Job Performance* (Master's thesis, Naval Postgraduate School, 1996), 16.

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[120] Ibid., 16.

[121] Ibid., 19.

[122] Ibid., 20.

Table 12.    Schaffer's Discriminant Analysis Formula

$$S_i^j = (\mu_i^T \Sigma^{-1}) U_i^j - \frac{1}{2}(\mu_i^T \Sigma^{-1} \mu_i) + \log(\pi_i) \qquad \forall i$$

| Variable | Definition |
|----------|------------|
| $i$ | Total number of courses considered |
| $j$ | An individual |
| $\mu_i$ | Vector of mean predicted values |
| $\Sigma^{-1}$ | Inverse of the dispersion matrix |
| $U_i^j$ | Vector of an individual's predictor values |
| $\pi_i$ | Percentage of individuals assigned to course $i$ |

Source: Robert J. Schaffer III, *Relating the Armed Services Vocational Aptitude Battery to Marine Job Performance* (Master's thesis, Naval Postgraduate School, 1996), 20.

A tree-model was used to examine each school individually in an attempt to discern the classification method of trainees. Individuals with higher FCGs were then identified by splits in the tree structure using composite scores. As the tree model grew to fit the data set, any over-fit was reduced to more accurately represent an entire population or future populations.[123]

Schaffer's discriminant method results concluded that ASVAB composite scores placed individuals in the same, or similar, courses as their original MOS selection. For all cases, more individuals were assigned to their original MOS than to other courses. Additionally, the study confirmed that individuals with higher ASVAB composite scores outperformed those with lower scores. Inclusion of additional composite scores indicated small improvements to Final Course Grades.[124]

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[123] Ibid., 21.

[124] Ibid., 29.

## 2. The Relationship between ASVAB and Training School Performance for USMC Field Radio Operators

In 2005, Catherine M. Hiatt conducted a study in conjunction with CNA to validate use of the ASVAB EL composite score as an effective predictor of training performance for Marine Corps Field Radio Operators.[125] A total of 1,519 cases were collected from the Marine Corps training school for Field Radio Operators in Twentynine Palms, CA, to validate the model. The study was designed to determine if other ASVAB scoring metrics might increase success in the Field Radio Operators MOS and if the model was a valid predictor of success in other MOSs.[126]

The first step in the analysis examined the correlation between ASVAB subtest scores and training school performance. Because each course had minimum aptitude requirements, the size of the observed correlation between ASVAB scores and performance in a course-specific sample was lower than expected for an entire pool of recruits available for assignment. The study indicated all ASVAB subtests, except Assembling Objects, had fairly high validities.[127]

A stepwise regression identified which combination of subtests would best predict successful completion of Field Radio Operator training. Intercorrelation between subtests was considered and the best predictors were combined to create a composite that best predicted training performance. The results indicated that performance was influenced by math (AR and MK subtest scores) and technical (EI and AS) abilities.[128] Using the stepwise regression results, the study measured the validity of composite scores. The results indicated minimal difference in the validity of the composites tested and no difference between the best combination of subtests based on the stepwise regression and the EL composite score used by the Marine Corps for Field Radio Operator MOS selection (see Table 13).[129]

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[125] Hiatt, *The Relationship between ASVAB and Training School Performance for USMC Field Radio Operators.*

[126] Ibid., 2–3.

[127] Ibid., 10.

[128] Ibid., p. 12.

[129] Ibid., p. 14.

Table 13.     Hiatt's Composites and Validities

| Composite Definition | Validity |
|---|---|
| AR + EI | 0.63 |
| AR + EI + MK | 0.66 |
| AR + EI + MK + AS | 0.66 |
| AR + EI + MK + GS[*] | 0.66 |
| [*] These subtests currently comprise the EL composite. | |

The study also ran regressions to compare the slopes and intercepts for racial and gender subgroups.  Neither the slopes nor the intercepts were statistically different for any of the subgroups.  The slopes were found to be equivalent implying the EL composite score equally predicts performance for all racial and gender subgroups (see Table 14).[130]

Table 14.     Hiatt's Results of Subgroup Analysis

| Score Type | Subgroup | Slope F Value | Intercept F Value |
|---|---|---|---|
| True score estimate | Race | 0.20 | 0.01 |
|  | Gender | 0.03 | 0.60 |
| Observed score | Race | 0.16 | 0.89 |
|  | Gender | 0.00 | 1.47 |

The study concluded the ASVAB EL composite score was a valid predictor of training performance for the Field Radio Operator Course.  Of the various combinations

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[130] Ibid., p. 16.

of ASVAB subtests, the EL composite was the best for predicting training performance. The EL composite also served as valid predictor for both race and gender subgroups.[131]

### 3. Study of Standards Used to Screen Recruits for Assignment to the Communications Field in the U.S Marine Corps

In 2011, Leonard J. Rautio conducted a study to examine the relationship between ASVAB composite scores and success at the Communications Occupational Field Schools at Twentynine Palms, CA.[132] A sample of 9,921 Marines attending the school from FY 2006–FY 2009 was collected for analysis. The study was designed to determine the effects of ASVAB composite scores and other measures of performance on successfully completing initial training.[133]

Rautio used a probit regression because of the binary nature of the dependent variable. Binary response models are applicable if research is primarily concerned with response probability. The study focused on estimated P(success = 1| x), when x indicates a complete set of independent variables.[134] Five separate models were developed to test the effects of demographics, ability and education, composite scores, behavior, and multiple MOSs on the dependent variable of success.

The results of the study indicate that the ASVAB EL composite score was a valid predictor of success at the Marine Corps Communications School. The change of one standard deviation equated to a 1.2 percent improvement in the probability of success. Rautio recommended inclusion of final course grades or a determination for causes of failing to complete training, such as poor academic performance, behavioral problems, and reasons for medical disqualifications, as beneficial independent variables for model development.[135]

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[131] Ibid., 17.

[132] Rautio, *Study of the Standards Used to Screen Recruits for Assignment to the Communications Field in the U.S. Marine Corps*.

[133] Ibid., v.

[134] Ibid., 51.

[135] Ibid., 63.

## G.    CHAPTER SUMMARY

Based on the literature reviewed, personnel attrition and revocation are a concern for all branches of service.  Every individual disqualified from service or dropped from MOS training represents a significant cost that could be largely avoided with improved screening techniques. The ASVAB is a valid predictor of the cognitive ability required for military service, and the GT composite score is a valid predictor of potential success for MATC training.  Candidates with higher AFQT scores and more education are more likely, on average, to successfully complete MOS training.  Medical disqualifications are a major contributing factor to increased attrition rates.  Improved medical screening earlier in the recruitment and training process has the potential to decrease attrition and revocation.  Non-cognitive attributes influence attrition and revocation, but no useful metric of these traits is currently in use by the Marine Corps.  The NCAPS has been found to be successful in screening Navy personnel for success in training, and it may also prove beneficial for use by the Marine Corps.  Finally, as several studies indicate, revised metrics using established ASVAB subtest and composite scores may prove beneficial in decreasing personnel attrition and revocation rates.  The following chapter provides background on the data sources and variables used in this study.

# IV. DATA SOURCES, VARIABLE DESCRIPTIONS, AND SUMMARY STATISTICS

The purpose of this chapter is to provide background information on the data sources used in this study. This chapter describes the dependent and independent variables used and the reasons for inclusion. Finally, the chapter provides an overview of the data analyzed through variable tabulations and descriptive statistics.

## A. DATA SOURCES

The following subsections describe the data providers for this study. Researchers chose these providers based on their collective ability to supply information concerning demographics, education levels, ASVAB scores, fiscal years of MATC Basic Course attendance, school completion codes, and revocation information.

### 1. Total Forces Data Warehouse (TFDW)

The Marine Corps Total Forces Data Warehouse (TFDW) supplied a majority of data for this study. TFDW is the information storage repository for the Manpower Plans and Policy Division of Headquarters Marine Corps (HQMC). The database stores information on all active duty and reserve component Marines, including demographics, enlistment information, testing scores, security clearance material, military occupational specialty (MOS) information, limited medical data, and other data deemed appropriate to track for manpower purposes. The TFDW was used to compile demographic, MOS, testing, and personnel attrition, and revocation data.

The TFDW data provided a snapshot for all Marines who attended the MATC Basic Course between FY1999–FY2008. The initial sample drawn from TFDW included 965 Marines. From this sample, 243 observations were deleted due to missing or inaccurate data, leaving 722 observations for the study (see Table 15). Of the 243 dropped observations, three were eliminated due to an AFQT score below ten (these individuals cannot enlist in the Marine Corps) and 240 were dropped due to ASVAB Composite scores of zero (indicating these scores were missing or an alternate enlistment test was used) (see Table 16).

Table 15.    Marines Attending the Marine Corps Air Traffic Control Basic Course from FY1999 to FY2008

| Sample Details | Number of Observations |
|---|---|
| Initial Sample | 965 |
| Missing or Dropped | 243 |
| Final Sample | 722 |

Source: U.S. Marine Corps Total Forces Data Warehouse (2012).

Table 16.    Restriction Details for TFDW Observations Dropped

| Observations Dropped | Number Removed | Explanation |
|---|---|---|
| AFQT < 10 | 3 | Individuals with an AFQT score below 10 are prohibited from enlisting. |
| ASVAB Composite Score (GT, EL, MM, CL) of 0 | 240 | ASVAB composite scores of 0 indicate data are missing or use of alternate enlistment test. |

Source: U.S. Marine Corps Total Forces Data Warehouse (2012).

## 2.    Headquarters Marine Corps, Expeditionary Enablers Branch, Command and Control Group-25 (APX-25)

APX-25 is a command & control group of Headquarters Marine Corps, Expeditionary Enablers Branch, located within The Pentagon.  This group is tasked with monitoring command & control functions for all MATC MOSs.  APX-25 supplied data on the total population of 565 Marines revoked from MATC MOSs between FY1994– FY2010.  The dataset included dates of revocation, the facility where revocation occurred, age and rank at the time of revocation, MOS, ATC position, prior MATC qualifications, ASVAB GT scores, and the reasons for revocation.

Data were compiled through a snapshot using the date Marines were revoked from a MATC MOS between FY1994–FY2010.  These fiscal years were further restricted for this study to FY1998–FY2010 to match the data provided by TFDW.  The

initial sample drawn from APX-25 included 579 Marines. From this sample, 418 observations were eliminated because they fell outside the window of the data provided by TFDW, leaving 161 revocation observations for study (see Table 17). Of the 418 observations dropped, 113 were due to unnecessary fiscal year observations (FYs 1994–1997), 289 due to no match between TFDW and APX-25 data, and 16 due to revocation mismatches between TFDW and APX-25 data for Marines who revoked from operational forces but did not graduate the MATC Basic Course (this outcome cannot occur) (see Table 18).

Table 17.    Marines Revoked from a MATC MOS from FY1999 to FY2008

| Sample Details | Number of Observations |
|---|---|
| Initial Sample | 579 |
| Missing or Dropped | 418 |
| Final Sample | 161 |

Source: Headquarters, U.S. Marine Corps, APX-25 (2012).

Table 18.    Restriction Details for APX-25 Observations Dropped

| Observations Dropped | Number Removed | Explanation |
|---|---|---|
| Unnecessary Fiscal Year observations (FY1994–FY1997) | 113 | Observations not within the Fiscal Years of the study and not required for analysis. |
| Improper matching criteria | 289 | No match between TFDW data for MATC course attendance & APX-25 data for revocation from MATC MOS. |
| Revocation Reasons | 16 | Combination of TFDW & APX-25 indicated 16 cases of revocation for Marines who did not graduate from the MATC Basic Course. This outcome cannot occur. |

Source: Headquarters, U.S. Marine Corps, APX-25 (2012).

## B.    VARIABLE DESCRIPTIONS

The following subsections describe the variables used in this study. Researchers included all available variables used for correlating success, attrition, or revocation.

### 1.    Passed Dependent Variable

The data were analyzed by examining all Marines entering the MATC Basic Course during each fiscal year. The "Passed" dependent variable is a dummy variable identifying whether an observed Marine successfully graduated from the MATC Basic Course. The variable takes a value of one if graduation occurred or a value of zero if graduation did not occur. Any Marine who did not receive the pass code indicated attrition from the course; Marines who attrited from training were assigned a value of zero.

Academic failures are the major reason for attrition from the MATC Basic Course. However, reasons for attrition also include medical disqualification, security and legal issues, substance abuse, and voluntary separation (drop on request). Marines are typically given the opportunity to retake blocks of instruction (rolled back) if instructors believe the individual has the ability to successfully complete training. Within the MATC Basic Course, the amount of time a Marine is allowed to remain in training is determined at the discretion of the school command. No standardized policy exists that covers every contingency for attrition. Each case is thoroughly analyzed to determine if an individual possesses the required abilities to successfully graduate. Similar to the method used in Rautio's study, Marines who are rolled back and subsequently pass the course are considered graduates and assigned a one for regression purposes.[136]

### 2.    Revoked Dependent Variable

The "revoked" dependent variable is a binary variable identifying whether an observed Marine revoked from any MATC MOS. The variable takes a value of one if revocation occurred or a value of zero if revocation did not occur. The data were

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[136] Rautio, *Study of the Standards Used to Screen Recruits for Assignment to the Communications Field in the U.S. Marine Corps*, 35.

analyzed by examining all Marines who successfully completed the MATC Basic Course and entered operational forces from FY1998–FY2010. TFDW data were merged with APX-25 data to determine if revocation from a MATC PMOS occurred.

The reasons for revocation from a MATC MOS are similar to those for attrition from the MATC Basic Course with an important caveat. The mission of MATC Basic Course leadership is determining whether a Marine has the ability to be trained as an air traffic controller. The focus is on trainability. The Marines who cannot be trained attrite from the course. The mission of MATC leadership in the operational forces is to determine whether a Marine has the ability to successfully execute the duties of the assigned PMOS. The focus is on proficiency. Marines who cannot fulfill PMOS requirements are revoked. Inherent in this process is the assumption that all Marines who graduate from the MATC Basic Course have the prerequisite skills to advance within the MATC community. However, previous studies of MATC revocation suggest this assumption is questionable.[137] This study attempts to further clarify the variables correlated with higher revocation rates.

### 3. Demographic Independent Variables

Demographic variables were selected based on the personnel attrition and revocation literature reviewed in Chapter III of this study. Previous studies indicate that these variables contribute to attrition and revocation within every branch of military service and, more specifically, to civilian and military air traffic control communities.[138] Information on marital status was excluded from analysis based on previous studies

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[137] Marine Corps Studies Program Support, *Marine Air Traffic Control Training and Revocations Study*, ES.3 – ES.4.

[138] U.S. General Accounting Office, *Military Attrition: Better Data, Coupled With Policy Changes, Could Help the Service Reduce Early Separations*.

indicating that over 96 percent of Marine Corps recruits are single at the time of their enlistment, and most Marines begin PMOS training within 6–8 months of enlistment.[139, 140]

### a. Gender

For observations indicating the sex of the individual is male, a value of one is given; females are given a value of zero. Prior studies indicate that women are more likely, on average, than men to attrite from the military.[141]

### b. Race

Race information was captured by the creation of dummy variables coded for the following races: White, Black, Asian, Native American, and Other. The Other variable is a composite of Marines who chose "other" for race or did not choose any race. Previous studies have shown that determining race is an important aspect of model validation.[142] Certain occupations require the inclusion of a racial demographic for manning purposes.[143] Additionally, screening metrics for testing scores are measured against racial demographics to minimize the potential for unwarranted selection criteria bias.

### c. Ethnicity

Ethnicity information was captured by the creation of binary variables coded for the following ethnic groups: Hispanic, Caucasian, Black, Native American, Asian, and Other. The Other variable is a composite of Marines who chose "other" for ethnicity or did not respond. Previous studies indicate demographic variables are

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[139] Robert E. Baczkowski Jr., *The Effects of End-of-Month Recruiting on Marine Corps Depot Attrition* (master's thesis, Naval Postgraduate School, 2006), 21.

[140] Annemarie Randazzo-Matsel, *USMC Training: A Synthesis of CNA's Work* (Washington, DC: CNA, 2008), 34.

[141] Rautio, *Study of the Standards Used to Screen Recruits for Assignment to the Communications Field in the U.S. Marine Corps*, 36.

[142] Ibid.

[143] Ibid.

important controls.[144] Certain occupations require the inclusion of ethnic demographics for manning purposes.[145]  Additionally, screening metrics for testing scores are measured against ethnic demographics to minimize the potential for unwarranted selection criteria bias.

### 4.  Service and Other Independent Variables

Service and other variables were selected based on the attrition and revocation literature reviewed in Chapter III of this study.  Previous studies indicate these variables contribute to attrition and revocation within every branch of military service and, more specifically, to civilian and military air traffic control communities.  This study attempts to control for any variable that may affect personnel attrition and revocation.

#### a.  *Fiscal Year (FY)*

Fiscal Year (FY) variables (**FY99, FY01, FY02, FY03, FY04, FY05, FY06, FY07, FY08**) take a value of one if a Marine attended the MATC Basic Course during that fiscal year.  Fiscal year dummy variables aid in determining the effect of the economy or service during that FY that may contribute to personnel attrition and revocation.  Additionally, fiscal year dummy variables suggest possible changes to instructional techniques, class size, leadership impact, and other factors influencing the MATC Basic Course that may affect personnel attrition and revocation.

#### b.  *AFQT Score*

AFQT scores are used as a proxy for the cognitive ability of a Marine.  A study conducted by Mark J. Eitelberg found that AFQT scores are a valid indicator of

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[144] Ibid.

[145] Ibid.

trainability.[146]  An additional study by Knapik et al. suggests that higher AFQT scores are associated with lower rates of personnel attrition and revocation, but the effect may not be significant.[147]

### c.    ASVAB Composite Scores

The key composite score for this study is the GT score.  The other composite scores (CL, EL, & MM) aid in controlling their effect on the dependent variable.  See Chapter II of this study for ASVAB composite score information.

### d.    Education

Education information is entered as a categorical variable to control for the level of formal education completed by a Marine.  Education is considered a measure of cognitive ability.  The **HSG** variable takes a value of one for Marines who receive a high school diploma.  This designation is determined by having 12 years of education.  The **NHG** variable takes the value of one for Marines who have not received a high school diploma.  This includes Marines who have less than 12 years of education or possess a GED.  The **MT_HSG** variable takes the value of one for Marines who have more education than a high school diploma.  This designation includes individuals with more than 12 years of formal schooling to include associate, bachelor's level, graduate, and postgraduate collegiate education.

### e.    Revocation Reasons

A primary purpose of this study is to ascertain if Marines within MATC MOSs possess similar characteristics that are useful for identifying potential revocation during their career.  Six specific variables were created for this study to delineate the main reasons for revocation, to include the following reasons and bolded variable names: [1] Denied Security Clearance (**Den_Clnc**); [2] Dropped on Request (**DOR**); [3] Failure

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[146] Mark J. Eitelberg, *Manpower for Military Occupations* (Alexandria, VA: Human Research Resources Organization, 1988), 30.

[147] Joseph K. Knapik et al. *A Review of the Literature on Attrition from the Military Services: Risk Factors for Attrition and Strategies to Reduce Attrition* (Fort Knox, KY: Center For Accessions Research, 2004), 10.

to Qualify (**FTQ**); [4] Misconduct (**MC**); [5] Not Physically Qualified (**NPQ**); and [6] Unsatisfactory Performance (**Unsat**). The 2011 Northrop Grumman MATC study suggests that these categories encompass a majority of the reasons that Marines with MATC MOSs are revoked.[148]

### f.      Revocation Notes

To further delineate possible causes of MATC revocation, specific descriptions of the revocation reasons were provided by APX-25 including the following ten categories and bolded variable names: [1] Alcohol (**Alcohol**); [2] Drugs (**Drugs**); [3] Lack of Accountability (**LoAcc**); [4] Lack of Awareness (**LoAware**); [5] Lack of Effort (**LoEff**); [6] Lack of English skills (**LoEng**); [7] Lack of Retention (**LoRetent**); [8] Medical (**Med**); [9] Morals (**Morals**); and [10] Psychological Issues (**Psych**). Interviews outlined in the 2011 Northrop Grumman MATC study suggest that these variables are ideal indicators in determining revocation reasons.[149]

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[148] Marine Corps Studies Program Support, *Marine Air Traffic Control Training and Revocations Study*, 3.15.

[149] Ibid., C.77–C.87.

## C. DESCRIPTIVE STATISTICS

### 1. Summary Statistics of All Variables

Table 19 contains a summary of the descriptive statistics variables used in this study to measure attrition from the MATC Basic Course and revocation from MATC MOSs. These findings are similar to conclusions provided in similar prior studies focusing on air traffic control attrition and revocation.[150] White Caucasian males are the dominant observation group.

Table 19.  TDescriptive Statistics for All Variables

| Variable | Mean | Standard Deviation | Range |
|----------|------|--------------------|-------|
| Passed | .80 | .40 | 1 = Passed<br>0 = Otherwise |
| Revoked | .20 | .40 | 1 = Passed<br>0 = Otherwise |
| AFQT | 72 | 13.81 | 34–99 |
| GT | 115 | 8.78 | 72–148 |
| EL | 113 | 9.75 | 89–146 |
| CL | 114 | 8.86 | 91–141 |
| MM | 112 | 11.42 | 73–146 |
| Male | .93 | .25 | 1 = Male<br>0 = Otherwise |
| Female | .07 | .25 | 1 = Female<br>0 = Otherwise |
| NHG | .03 | .17 | 1 = < 12 years education<br>0 = Otherwise |
| HSG | .94 | .24 | 1 = 12 years education<br>0 = Otherwise |
| MT_HSG | .03 | .18 | 1 = > 12 years education<br>0 = Otherwise |
| White_R | .80 | .40 | 1 = White Race<br>0 = Otherwise |

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[150] Marine Corps Studies Program Support, *Marine Air Traffic Control Training and Revocations Study*.

| | | | |
|---|---|---|---|
| **Black_R** | .07 | .26 | 1 = Black Race<br>0 = Otherwise |
| **Asian_R** | .02 | .13 | 1 = Asian Race<br>0 = Otherwise |
| **AmerIndian_R** | .02 | .12 | 1 = Native American Race<br>0 = Otherwise |
| **Other_R** | .09 | .28 | 1 = Other Race or Declined to Answer<br>0 = Otherwise |
| **European_Anglo_E** | .38 | .47 | 1 = Caucasian Ethnicity<br>0 = Otherwise |
| **Hispanic_E** | .13 | .34 | 1 = Hispanic Ethnicity<br>0 = Otherwise |
| **Black_E** | .04 | .19 | 1 = Black Ethnicity<br>0 = Otherwise |
| **Asian_E** | .01 | .11 | 1 = Asian Ethnicity<br>0 = Otherwise |
| **AmerIndian_E** | .02 | .14 | 1 = Native American Ethnicity<br>0 = Otherwise |
| **Other_E** | .42 | .49 | 1 = Other Ethnicity or Declined to Answer<br>0 = Otherwise |
| **FY99** | .05 | .21 | 1 = School Completion in FY1999<br>0 = Otherwise |
| **FY00** | .06 | .24 | 1 = School Completion in FY2000<br>0 = Otherwise |
| **FY01** | .06 | .24 | 1 = School Completion in FY2001<br>0 = Otherwise |
| **FY02** | .12 | .32 | 1 = School Completion in FY2002<br>0 = Otherwise |
| **FY03** | .05 | .21 | 1 = School Completion in FY2003<br>0 = Otherwise |
| **FY04** | .03 | .17 | 1 = School Completion in FY2004<br>0 = Otherwise |
| **FY05** | .18 | .38 | 1 = School Completion in FY2005<br>0 = Otherwise |
| **FY06** | .18 | .38 | 1 = School Completion in FY2006<br>0 = Otherwise |
| **FY07** | .19 | .39 | 1 = School Completion in FY2007<br>0 = Otherwise |
| **FY08** | .07 | .25 | 1 = School Completion in FY2008 |

| | | | |
|---|---|---|---|
| | | | 0 = Otherwise |
| **Den_Clnc** | .0014 | .037 | 1 = Denied Clearance |
| | | | 0 = Otherwise |
| **DOR** | .0014 | .037 | 1 = Dropped on Request |
| | | | 0 = Otherwise |
| **FTQ** | .10 | .30 | 1 = Failure to Qualify |
| | | | 0 = Otherwise |
| **MC** | .01 | .10 | 1 = Misconduct |
| | | | 0 = Otherwise |
| **NPQ** | .04 | .20 | 1 = Not Physically Qualified |
| | | | 0 = Otherwise |
| **Unsat** | .0055 | .074 | 1 = Unsatisfactory Performance |
| | | | 0 = Otherwise |
| **Alcohol** | .0042 | .064 | 1 = Alcohol |
| | | | 0 = Otherwise |
| **Drugs** | .0055 | .074 | 1 = Drugs |
| | | | 0 = Otherwise |
| **LoAcc** | .0014 | .037 | 1 = Lack of Accountability |
| | | | 0 = Otherwise |
| **LoAware** | .0083 | .091 | 1 = Lack of Awareness |
| | | | 0 = Otherwise |
| **LoEff** | .0014 | .037 | 1 = Lack of Effort |
| | | | 0 = Otherwise |
| **LoEng** | .0014 | .037 | 1 = Lack of English Proficiency |
| | | | 0 = Otherwise |
| **LoRetent** | .0014 | .037 | 1 = Lack of Retention |
| | | | 0 = Otherwise |
| **Med** | .0083 | .091 | 1 = Medical |
| | | | 0 = Otherwise |
| **Morals** | .0014 | .037 | 1 = Moral Problem in Past |
| | | | 0 = Otherwise |
| **Psych** | .011 | .10 | 1 = Psychological Issue |
| | | | 0 = Otherwise |

Source: U.S. Marine Corps, Total Forces Data Warehouse (2012).
Note: Data manipulated by STATA statistical software.

### 2. Cross Tabulation of Key Variables by Passing the MATC Basic Course

Tables 20 through 28 indicate the passing rate percentages from the MATC Basic Course by demographic characteristics. The information provided in these tables is useful in determining trends and characteristics for success in MATC training. Additionally, these tables provide a benchmark for comparison to prior studies concerning first term attrition from the Marine Corps and attrition from air traffic control basic training courses for the FAA and other military services.

Table 20 presents a summary of passing rate percentages for the MATC Basic Course by gender. Results indicate passing rate percentages are nearly identical between males and females.

Table 20.  Passing by Gender

| Gender | Frequency | Passing Rate % |
|---|---|---|
| Male | 541 | 80.27 |
| Female | 38 | 79.17 |

Source: U.S. Marine Corps, Total Forces Data Warehouse (2012).
Note: Data manipulated by STATA statistical software.

Table 21 is a summary of passing rate percentages for the MATC Basic Course by race. Passing rate percentages are all within 10 percentage points of 80.1 percent indicated for Whites. The highest passing percentage was for Native Americans (90.9 percent), and the lowest was for Blacks (74.1 percent).

Table 21.  Passing by Race

| Race | Frequency | Passing Rate % |
|---|---|---|
| White | 466 | 80.84 |
| Black | 40 | 74.07 |
| Asian | 11 | 84.62 |
| Native American | 10 | 90.91 |
| Other | 52 | 81.25 |

Source: U.S. Marine Corps, Total Forces Data Warehouse (2012).
Note: Data manipulated by STATA statistical software.

Table 22 is a summary of passing rate percentages for the MATC Basic Course by ethnicity. Ethnicity differences between Caucasian, Hispanic, and Asians are minimal (within 4 percentage points). Native Americans have the highest passing rate percentage (92.9 percent), and Blacks have the lowest (69 percent).

Table 22.    Passing by Ethnicity

| Race | Frequency | Passing Rate % |
|---|---|---|
| Caucasian | 225 | 81.82 |
| Hispanic | 74 | 79.57 |
| Black | 18 | 69.23 |
| Asian | 7 | 77.78 |
| Native American | 13 | 92.86 |
| Other | 242 | 79.34 |

Source: U.S. Marine Corps, Total Forces Data Warehouse (2012).
Note: Data manipulated by STATA statistical software.

Table 23 is a summary of passing rate percentages for the MATC Basic Course by Fiscal Year. The passing rate percentages drop significantly between FY2001 to FY2002 and begin a steady increase to the highest rate in FY2005. These fluctuations could indicate changes in instructors, instructional technique, class size, or command influence.

Table 23.    Passing by Fiscal Year

| Fiscal Year (FY) | Frequency | Passing Rate % |
|---|---|---|
| FY99 | 30 | 90.91 |
| FY00 | 42 | 93.33 |
| FY01 | 39 | 88.64 |
| FY02 | 57 | 67.06 |
| FY03 | 25 | 71.43 |
| FY04 | 15 | 71.43 |
| FY05 | 107 | 84.25 |
| FY06 | 103 | 81.10 |
| FY07 | 100 | 74.63 |
| FY08 | 39 | 81.25 |

Source: U.S. Marine Corps, Total Forces Data Warehouse (2012).
Note: Data manipulated by STATA statistical software.

Table 24 is a summary of passing rate percentages for the MATC Basic Course by AFQT score and category. These results are similar to a majority of previous ASVAB studies suggesting an increase in AFQT score correlates with an increase in the percentage of individuals who successfully complete military training courses.[151]

Table 24.    Passing by AFQT Score and Category

| AFQT Score Range / Category | Frequency | Passing Rate % |
|---|---|---|
| 92–99 / I | 53 | 88.33 |
| 65–92 / II | 357 | 83.02 |
| 50–64 / IIIA | 158 | 76.70 |
| 31–49 / IIIB | 11 | 42.31 |

Source: U.S. Marine Corps, Total Forces Data Warehouse (2012).
Note: Data manipulated by STATA statistical software.

Table 25 is a summary of passing rate percentages for the MATC Basic Course by ASVAB GT composite score. When measured by frequency, the results suggest that an increase in GT Score also increases passing rates. This finding is similar to previous studies suggesting an increase in ASVAB composite scores correlates to an increase in successfully passing military training courses.[152] Of note is the number of observations below the minimum GT score of 110 required to enter the Air Traffic Control–Trainee MOS (7251). The passing rate of individuals scoring from 100 to 109 is 8 percentage points below those scoring in the range of 110 to 119. This difference in rates indicates that maintaining the GT score requirement of 110 or higher for acceptance into training would increase the likelihood of passing the MATC Basic Course. The acceptance of Marines into training with a GT score below 110 is likely a result of Marine Corps manpower requirements to replace individuals who attrite, revoke, or leave the MOS at the end of obligated service.

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[151] Quester, *Marine Corps Recruits: A Historical Look at Accessions and Bootcamp Performance.*

[152] Ibid.

Table 25.     Passing by ASVAB GT Composite Score

| GT Score Range | Frequency | Passing Rate % |
|---|---|---|
| 70–79 | 2 | 100.00 |
| 90–99 | 1 | 100.00 |
| 100–109 | 144 | 72.36 |
| 110–119 | 249 | 80.32 |
| 120–129 | 136 | 87.74 |
| 130–139 | 43 | 84.31 |
| 140–149 | 4 | 100.00 |

Source: U.S. Marine Corps, Total Forces Data Warehouse (2012).

Note: Data manipulated by STATA statistical software.

Table 26 is a summary of passing rate percentages for the MATC Basic Course by ASVAB EL composite score.  When measured by frequency, the results suggest that an increase in EL Score also increases passing rate.  This finding is similar to previous studies suggesting an increase in ASVAB composite scores correlates with an increase in successfully passing military training courses.[153]

Table 27 is a summary of passing rate percentages for the MATC Basic Course by ASVAB CL composite score.  When measured by frequency, the results suggest that an increase in CL score also increases passing rate.  This finding is similar to previous studies suggesting an increase in ASVAB composite scores correlates with an increase in successfully passing military training courses.[154]

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[153] Rautio, *Study of the Standards Used to Screen Recruits for Assignment to the Communications Field in the U.S. Marine Corps*.

[154] Ibid.

Table 26.     Passing by ASVAB EL Composite Score

| EL Score Range | Frequency | Passing Rate % |
|---|---|---|
| 80–89 | 1 | 100.00 |
| 90–99 | 31 | 70.45 |
| 100–109 | 170 | 75.56 |
| 110–119 | 202 | 79.53 |
| 120–129 | 142 | 89.31 |
| 130–139 | 31 | 86.11 |
| 140–149 | 3 | 100.00 |

Source: U.S. Marine Corps, Total Forces Data Warehouse (2012).

Note: Data manipulated by STATA statistical software.

Table 27.     Passing by ASVAB CL Composite Score

| CL Score Range | Frequency | Passing Rate % |
|---|---|---|
| 90–99 | 15 | 51.72 |
| 100–109 | 162 | 74.65 |
| 110–119 | 236 | 82.52 |
| 120–129 | 134 | 86.45 |
| 130–139 | 31 | 91.18 |
| 140–149 | 1 | 100.00 |

Source: U.S. Marine Corps, Total Forces Data Warehouse (2012).

Note: Data manipulated by STATA statistical software.

Table 28 is a summary of passing rate percentages for the MATC Basic Course by ASVAB MM composite score. A notable drop in passing rate percentage between the frequency ranges of 90–99 to 100–109.

Table 28.    Passing by ASVAB MM Composite Score

| MM Score Range | Frequency | Passing Rate % |
|---|---|---|
| 70–79 | 2 | 100.00 |
| 80–89 | 2 | 66.67 |
| 90–99 | 81 | 79.41 |
| 100–109 | 166 | 73.45 |
| 110–119 | 173 | 81.99 |
| 120–129 | 113 | 84.96 |
| 130–139 | 35 | 92.11 |
| 140–149 | 7 | 100.00 |

Source: U.S. Marine Corps, Total Forces Data Warehouse (2012).

Note: Data manipulated by STATA statistical software.

### 3.    Cross Tabulation of Key Variables by Revocation from MATC MOSs

Tables 29 through 37 measure demographic characteristics for Marines revoked from MATC MOSs between FY1999–FY 2008.  These tables are useful in analyzing the traits and characteristics that contribute to the likelihood of revocation.  Additionally, these tables aid in determining the validity of prior studies concerning revocation within the Marine Corps and revocation from the FAA and air traffic control specialties in other branches of service.

Table 29 is a summary of revocation rates from MATC MOSs by gender. Results indicate that more men are revoked at a higher rate than women. These results are similar to the findings within Rautio (2011) of entry-level training attrition from the Marine Corps Communication School.[155]

Table 29.    Revocation by Gender

| Gender | Frequency | Revocation Rate % |
|--------|-----------|-------------------|
| Male   | 112       | 20.70             |
| Female | 4         | 10.53             |

Source: U.S. Marine Corps, Total Forces Data Warehouse (2012).

Note: Data manipulated by STATA statistical software.

Table 30 is a summary of revocation rates from MATC MOSs by race. Whites have the highest frequency of revocation. Higher revocation rates for Blacks correspond with findings earlier in this study regarding higher attrition rates for Blacks at the MATC Basic Course.

Table 30.    Revocation by Race

| Race            | Frequency | Revocation Rate % |
|-----------------|-----------|-------------------|
| White           | 98        | 21.03             |
| Black           | 12        | 30.00             |
| Asian           | 1         | 9.09              |
| Native American | 2         | 20.00             |
| Other           | 3         | 5.77              |

Source: U.S. Marine Corps, Total Forces Data Warehouse (2012).

Note: Data manipulated by STATA statistical software.

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[155] Ibid.

Table 31 is a summary of revocation rates from MATC MOSs by ethnicity. Caucasian ethnicity has the highest frequency of revocation, corresponding with the findings of previous studies that suggest a majority of individuals with this ethnic background are White.[156]  Blacks have the highest revocation rates  (33.33 percent), and Hispanics have the lowest (20.27 percent).

Table 31.    Revocation by Ethnicity

| Race | Frequency | Revocation Rate % |
|---|---|---|
| Caucasian | 51 | 22.67 |
| Hispanic | 15 | 20.27 |
| Black | 6 | 33.33 |
| Asian | 2 | 28.57 |
| Native American | 3 | 23.08 |
| Other | 39 | 16.12 |

Source: U.S. Marine Corps, Total Forces Data Warehouse (2012).

Note: Data manipulated by STATA statistical software.

Table 32 is a summary of revocation rates from MATC MOSs by Fiscal Year. Lower frequencies of observations for FY99–FY04 and FY08 are most likely the byproduct of a matching discrepancy between the data provided by TFDW personnel who attended the MATC Basic Course and the data provided by APX-25 personnel who revoked from operational forces.  Merged data had the highest frequency of matches between FY05–FY07; therefore, revocation rates from these three years are most accurate.  Restricting analysis to fiscal years with high frequency indicates revocation rates average 23 percent with minimal deviation.

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[156] Ibid.

Table 32.    Revocation by Fiscal Year

| Fiscal Year (FY) | Frequency | Revocation Rate % |
|---|---|---|
| FY99 | 6 | 20.00 |
| FY00 | 5 | 11.90 |
| FY01 | 4 | 10.26 |
| FY02 | 8 | 14.04 |
| FY03 | 6 | 24.00 |
| FY04 | 4 | 26.67 |
| FY05 | 25 | 23.36 |
| FY06 | 23 | 22.33 |
| FY07 | 25 | 25.00 |
| FY08 | 5 | 12.82 |

Source: U.S. Marine Corps, Total Forces Data Warehouse (2012).
Note: Data manipulated by STATA statistical software.

Table 33 presents a summary of revocation rates from MATC MOSs by AFQT score and category.  Categories I–IIIA revocation rates are within two percentage points. Several previous studies suggest that an increase in AFQT scores decreases the probability of training attrition.[157] However, training attrition and operational revocation occur at different points in career progression, with potentially diverging influences. These preliminary summary statistics indicate that AFQT score and category may not be a good predictor of revocation rates.  This finding suggests either the differences in categories are minimal or factors beyond cognitive ability influence revocation.

Table 33.    Revocation by AFQT Score & Category

| AFQT Score Range / Category | Frequency | Revocation Rate % |
|---|---|---|
| 92–99 / I | 11 | 20.75 |
| 65–92 / II | 70 | 19.61 |
| 50–64 / IIIA | 32 | 20.25 |
| 31–49 / IIIB | 3 | 27.27 |

Source: U.S. Marine Corps, Total Forces Data Warehouse (2012).
Note: Data manipulated by STATA statistical software.

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[157] Aline O. Quester, *Marine Corps Recruits: A Historical Look at Accessions and Bootcamp Performance* (Washington D.C.: CNA).

Table 34 is a summary of revocation rates for MATC MOSs by ASVAB GT composite score. Higher frequency GT score ranges have revocation rates separated by only four percentages points, suggesting either the differences in ranges are minimal or factors beyond cognitive ability influence revocation.

Table 34.    Revocation by ASVAB GT Composite Score

| GT Score Range | Frequency | Revocation Rate % |
|---|---|---|
| 100–109 | 27 | 18.75 |
| 110–119 | 48 | 19.28 |
| 120–129 | 32 | 23.53 |
| 130–139 | 7 | 16.28 |
| 140–149 | 2 | 50.00 |

Source: U.S. Marine Corps, Total Forces Data Warehouse (2012).
Note: Data manipulated by STATA statistical software.

Table 35 is a summary of revocation rates for MATC MOSs by ASVAB EL composite score.  Similar to the previous results for AFQT and GT scores, higher frequency EL score ranges have revocation rates separated by only 4 percentage points, suggesting either the differences in ranges are minimal or factors beyond cognitive ability influence revocation.

Table 35.    Revocation by ASVAB EL Composite Score

| EL Score Range | Frequency | Revocation Rate % |
|---|---|---|
| 90–99 | 7 | 22.58 |
| 100–109 | 31 | 18.24 |
| 110–119 | 39 | 19.31 |
| 120–129 | 31 | 21.83 |
| 130–139 | 8 | 25.81 |

Source: U.S. Marine Corps, Total Forces Data Warehouse (2012).
Note: Data manipulated by STATA statistical software.

Table 36 is a summary of revocation rates for MATC MOSs by ASVAB CL composite score. The results indicate CL score ranges of 110–119 have the highest observed frequency and the second lowest revocation rate percentage. The highest revocation rate percentage belonged to Marines scoring between 100–109.

Table 36.    Revocation by ASVAB CL Composite Score

| CL Score Range | Frequency | Revocation Rate % |
|---|---|---|
| 90–99 | 3 | 20.00 |
| 100–109 | 39 | 24.07 |
| 110–119 | 43 | 18.22 |
| 120–129 | 26 | 19.40 |
| 130–139 | 5 | 16.13 |

Source: U.S. Marine Corps, Total Forces Data Warehouse (2012).

Note: Data manipulated by STATA statistical software.

Table 37 is a summary of revocation rates for MATC MOSs by ASVAB MM composite score. If this composite were a valid metric for revocation, higher scores should equate to lower revocation rates. However, results of these summary statistics suggest the opposite occurs; revocation rates, when measured by higher frequency, increase as MM scores increase.

Table 37.    Revocation by ASVAB MM Composite Score

| MM Score Range | Frequency | Revocation Rate % |
|---|---|---|
| 90–99 | 18 | 22.22 |
| 100–109 | 31 | 18.67 |
| 110–119 | 28 | 16.18 |
| 120–129 | 29 | 25.66 |
| 130–139 | 10 | 28.57 |

Source: U.S. Marine Corps, Total Forces Data Warehouse (2012).

Note: Data manipulated by STATA statistical software.

**D. SUMMARY**

This chapter describes the data sources and variables used in the analysis of attrition from the MATC Basic Course and revocation from MATC MOSs. Variables were chosen based on previous studies on military first-term attrition, FAA training, and Marine Corps air traffic control career progression. Variables were summarized using statistical software to examine which characteristics are associated with MATC personnel attrition and revocation. The next chapter discusses the regression model used in this study and the results of analysis.

# V.    MODEL DEVELOPMENT, REGRESSION RESULTS, AND ANALYSIS

Given the binary nature of the dependent variables, probit regression models were employed to analyze the probability of successfully passing the MATC Basic Course and likelihood of revocation from MATC MOSs.  Key explanatory variables were selected based on previous research of military and FAA air traffic control training and MATC operational requirements.[158]  All regressions were conducted using the STATA statistical software package.

## A.    MODEL DEVELOPMENT

Two sets of models were developed: one set analyzing attrition and the other set analyzing revocation.

### 1.    Model #1: Effects of Demographics on Attrition at the MATC Basic Course

Model #1 measures the effects of demographics on attrition at the MATC Basic Course.  It includes the dependent variable (**Passed**) and independent variables for demographics and fiscal years. The base case for all models is a white Caucasian male who graduated from the MATC Basic Course in fiscal year 2008. The symbol $\Phi$ denotes the standard normal cumulative density function within all models.

P (**Passed** = 1|x) = $\Phi$ ($\beta_0$ + $\beta_1$**BLACK_R** + $\beta_2$**ASIAN_R** + $\beta_3$**AMERINDIAN_R** + $\beta_4$**OTHER_R** + $\beta_5$**HISPANIC_E** + $\beta_6$**BLACK_E** + $\beta_7$**ASIAN_E** + $\beta_8$**AMERINDIAN_E** + $\beta_9$**OTHER_E** + $\beta_{10}$**Female** + $\beta_{11}$**FY99** + $\beta_{12}$**FY00** + $\beta_{13}$**FY01** + $\beta_{14}$**FY02** + $\beta_{15}$**FY03** + $\beta_{16}$**FY04** + $\beta_{17}$**FY05** + $\beta_{18}$**FY06** + $\beta_{19}$**FY07** + **u**)

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[158] Marine Corps Studies Program Support, *Marine Air Traffic Control Training and Revocations Study*.

2. **Model #2: Effects of Education and Ability on Attrition at the MATC Basic Course**

Model #2 measures the effects of education and ability on attrition at the MATC Basic Course. It includes the dependent variable (**Passed**) and independent variables for demographics, fiscal years, and education. AFQT score serves as a proxy for cognitive ability. With the addition of education variables, the base case for attrition models is a white Caucasian male with a high school diploma who graduated the MATC Basic Course in fiscal year 2008.

$$P\,(\textbf{Passed} = 1|\text{x}) = \Phi\,(\beta_0 + \beta_1\textbf{BLACK\_R} + \beta_2\textbf{ASIAN\_R} + \beta_3\textbf{AMERINDIAN\_R} + \beta_4\textbf{OTHER\_R} + \beta_5\textbf{HISPANIC\_E} + \beta_6\textbf{BLACK\_E} + \beta_7\textbf{ASIAN\_E} + \beta_8\textbf{AMERINDIAN\_E} + \beta_9\textbf{OTHER\_E} + \beta_{10}\textbf{Female} + \beta_{11}\textbf{FY99} + \beta_{12}\textbf{FY00} + \beta_{13}\textbf{FY01} + \beta_{14}\textbf{FY02} + \beta_{15}\textbf{FY03} + \beta_{16}\textbf{FY04} + \beta_{17}\textbf{FY05} + \beta_{18}\textbf{FY06} + \beta_{19}\textbf{FY07} + \beta_{20}\textbf{NHG} + \beta_{21}\textbf{MT\_HSG} + \beta_{22}\textbf{AFQT} + \textbf{u})$$

3. **Model #3: Effects of ASVAB Composite Scores on Attrition from the MATC Basic Course**

Model #3 measures the effects of ASVAB composite scores on attrition at the MATC Basic Course. It includes the dependent variable (**Passed**) and independent variables for demographics, fiscal years, education, ability, and composite scores.

$$P\,(\textbf{Passed} = 1|\text{x}) = \Phi\,(\beta_0 + \beta_1\textbf{BLACK\_R} + \beta_2\textbf{ASIAN\_R} + \beta_3\textbf{AMERINDIAN\_R} + \beta_4\textbf{OTHER\_R} + \beta_5\textbf{HISPANIC\_E} + \beta_6\textbf{BLACK\_E} + \beta_7\textbf{ASIAN\_E} + \beta_8\textbf{AMERINDIAN\_E} + \beta_9\textbf{OTHER\_E} + \beta_{10}\textbf{Female} + \beta_{11}\textbf{FY99} + \beta_{12}\textbf{FY00} + \beta_{13}\textbf{FY01} + \beta_{14}\textbf{FY02} + \beta_{15}\textbf{FY03} + \beta_{16}\textbf{FY04} + \beta_{17}\textbf{FY05} + \beta_{18}\textbf{FY06} + \beta_{19}\textbf{FY07} + \beta_{20}\textbf{NHG} + \beta_{21}\textbf{MT\_HSG} + \beta_{22}\textbf{AFQT} + \beta_{23}\textbf{GT} + \beta_{24}\textbf{EL} + \beta_{25}\textbf{CL} + \beta_{26}\textbf{MM} + \textbf{u})$$

4. **Model #4: Effects of Demographics on Revocation from MATC MOSs**

Model #4 measures the effects of demographics on revocation from MATC MOSs. It includes the dependent variable (**Revoked**) and independent variables for demographics and fiscal years.

$$P(\textbf{Revoked} = 1|\text{x}) = \Phi(\beta_0 + \beta_1\textbf{BLACK\_R} + \beta_2\textbf{ASIAN\_R} + \beta_3\textbf{AMERINDIAN\_R} + \beta_4\textbf{OTHER\_R} + \beta_5\textbf{HISPANIC\_E} + \beta_6\textbf{BLACK\_E} + \beta_7\textbf{ASIAN\_E} + \beta_8\textbf{AMERINDIAN\_E} + \beta_9\textbf{OTHER\_E} + \beta_{10}\textbf{Female} + \beta_{11}\textbf{FY99} + \beta_{12}\textbf{FY00} + \beta_{13}\textbf{FY01} + \beta_{14}\textbf{FY02} + \beta_{15}\textbf{FY03} + \beta_{16}\textbf{FY04} + \beta_{17}\textbf{FY05} + \beta_{18}\textbf{FY06} + \beta_{19}\textbf{FY07} + \textbf{u})$$

### 5. Model #5: Effects of Education and Ability on Revocation from MATC MOSs

Model #5 measures the effects of education and ability on revocation from MATC MOSs. It includes the dependent variable (**Revoked**) and independent variables for demographics, fiscal years, education, and ability. AFQT score serves as a proxy for cognitive ability. With the addition of education variables, the base case for revocation models is a white Caucasian male with a high school diploma who graduated the MATC Basic Course in fiscal year 2008.

$$P(\textbf{Revoked} = 1|\text{x}) = \Phi(\beta_0 + \beta_1\textbf{BLACK\_R} + \beta_2\textbf{ASIAN\_R} + \beta_3\textbf{AMERINDIAN\_R} + \beta_4\textbf{OTHER\_R} + \beta_5\textbf{HISPANIC\_E} + \beta_6\textbf{BLACK\_E} + \beta_7\textbf{ASIAN\_E} + \beta_8\textbf{AMERINDIAN\_E} + \beta_9\textbf{OTHER\_E} + \beta_{10}\textbf{Female} + \beta_{11}\textbf{FY99} + \beta_{12}\textbf{FY00} + \beta_{13}\textbf{FY01} + \beta_{14}\textbf{FY02} + \beta_{15}\textbf{FY03} + \beta_{16}\textbf{FY04} + \beta_{17}\textbf{FY05} + \beta_{18}\textbf{FY06} + \beta_{19}\textbf{FY07} + \beta_{20}\textbf{NHG} + \beta_{21}\textbf{MT\_HSG} + \beta_{22}\textbf{AFQT} + \textbf{u})$$

### 6. Model #6: Effects of ASVAB Composite Scores on Revocation from MATC MOSs

Model #6 measures the effects of ASVAB composite scores on revocation from MATC MOSs. It includes the dependent variable (**Revoked**) and independent variables for demographics, fiscal years, education, ability, and composite scores.

$$P(\textbf{Revoked} = 1|\text{x}) = \Phi(\beta_0 + \beta_1\textbf{BLACK\_R} + \beta_2\textbf{ASIAN\_R} + \beta_3\textbf{AMERINDIAN\_R} + \beta_4\textbf{OTHER\_R} + \beta_5\textbf{HISPANIC\_E} + \beta_6\textbf{BLACK\_E} + \beta_7\textbf{ASIAN\_E} + \beta_8\textbf{AMERINDIAN\_E} + \beta_9\textbf{OTHER\_E} + \beta_{10}\textbf{Female} + \beta_{11}\textbf{FY99} + \beta_{12}\textbf{FY00} + \beta_{13}\textbf{FY01} + \beta_{14}\textbf{FY02} + \beta_{15}\textbf{FY03} + \beta_{16}\textbf{FY04} + \beta_{17}\textbf{FY05} + \beta_{18}\textbf{FY06} + \beta_{19}\textbf{FY07} + \beta_{20}\textbf{NHG} + \beta_{21}\textbf{MT\_HSG} + \beta_{22}\textbf{AFQT} + \beta_{23}\textbf{GT} + \beta_{24}\textbf{EL} + \beta_{25}\textbf{CL} + \beta_{26}\textbf{MM} + \textbf{u})$$

## B. REGRESSION RESULTS AND ANALYSIS

Tables 38 and 39 summarize the probit regression results and estimated partial effects for the **Passed** dependent variable used in Model #1–Model #3. Tables 40 and 41 summarize the probit regression results and estimated partial effects for the **Revoked** dependent variable used in Model #4–Model #6. For all models, the results are indicated on average with all other variables held constant.

### 1. Model #1 Results

Model #1 indicates that ethnicity and gender are not statistically significant indicators of passing the MATC Basic Course.–Estimates indicate Asians have a 0.14 higher probability of passing than Marines who are white (significant at the 1 percent level). Chapter IV indicated that FY02 had the lowest percentage of passing the MATC Basic Course (67.06 percent). The results of the regression confirm this finding by indicating that a Marine who attended the MATC Basic Course in FY02 has a 0.21 higher probability of attriting than a Marine who attended in FY08 (significant at the 5 percent level). Students who attended the MATC Basic Course in FY07 have a 0.12 higher probability of attriting than students who attended in FY08 (significant at the 1 percent level).

### 2. Model #2 Results

Model #2 adds AFQT scores to the demographic variables in Model #1. Results indicate that each additional point scored on the AFQT score increases the probability of passing by 0.005 percentage points. Since a one-point increase in AFQT score is practically small, it is more useful to look at the effect of a one-standard deviation change in AFQT. According to Model #2 estimates, one standard deviation increase in AFQT increases the probability of passing by 6.6 percent points. These findings validate previous studies that found an increase in AFQT scores equates to an increase probability of successfully completing military training courses.[159] The AFQT score is statistically significant at the 1 percent level.

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[159] See Chapter III, Validation of ASVAB Screening Procedures, 32.

### 3.    Model #3 Results

In addition to the finding in the previous models, Marines with Native American ethnicity have a 0.12 higher probability of passing than Marines with Caucasian ethnicity. The passing rate for Native Americans equals 0.92 and the results are statistically significant at the 10 percent level.  Students who attended the MATC Basic Course in FY00 have a 0.10 higher probability of passing than those who attended in FY08.  The passing rate for FY00 Marines equals 0.90 and the results are statistically significant at the 10 percent level.  The statistical significance for Marines attriting in FY02 changes to 0.05.   Each additional point scored on the CL and MM composites increases the probability of passing by 0.007 percentage points and 0.006 percentage points, respectively.  One standard deviation in CL and MM score equals a 6 and 6.6 percentage points increase in the probability of passing, respectively.  The CL score is statistically significant at the 5 percent level and the MM score at the 10 percent level.

Table 38.    Probit Results for Passing MATC Basic Course

| EQUATION | VARIABLES | Model #1 Passed | Model #2 Passed | Model #3 Passed |
|---|---|---|---|---|
| **Passed** | Black_R | -0.0193 | -0.0278 | 0.103 |
| | | (0.289) | (0.294) | (0.303) |
| | Asian_R | 0.735 | 0.966 | 1.029 |
| | | (0.663) | (0.735) | (0.733) |
| | AmerIndian_R | 0.234 | 0.354 | 0.335 |
| | | (0.681) | (0.701) | (0.732) |
| | Other_R | 0.0724 | 0.134 | 0.131 |
| | | (0.206) | (0.211) | (0.213) |
| | Hispanic_E | -0.0882 | -0.0181 | 0.0414 |
| | | (0.187) | (0.190) | (0.194) |
| | Black_E | -0.279 | -0.149 | -0.262 |
| | | (0.401) | (0.409) | (0.412) |
| | Asian_E | -0.599 | -0.769 | -0.795 |
| | | (0.701) | (0.765) | (0.762) |
| | AmerIndian_E | 0.581 | 0.629 | 0.675 |
| | | (0.609) | (0.609) | (0.643) |
| | Other_E | -0.106 | -0.0849 | -0.0650 |
| | | (0.131) | (0.133) | (0.134) |
| | Female | 0.00602 | 0.0179 | 0.109 |

|  |  |  |  |
|---|---|---|---|
|  | (0.221) | (0.224) | (0.235) |
| FY99 | 0.285 | 0.353 | 0.423 |
|  | (0.363) | (0.377) | (0.378) |
| FY00 | 0.442 | 0.379 | 0.490 |
|  | (0.345) | (0.351) | (0.360) |
| FY01 | 0.140 | 0.0983 | 0.116 |
|  | (0.318) | (0.323) | (0.325) |
| FY02 | -0.641*** | -0.726*** | -0.670*** |
|  | (0.236) | (0.241) | (0.244) |
| FY03 | -0.519* | -0.562* | -0.521* |
|  | (0.297) | (0.300) | (0.308) |
| FY04 | -0.491 | -0.554 | -0.532 |
|  | (0.349) | (0.354) | (0.357) |
| FY05 | -0.0698 | -0.0728 | -0.0442 |
|  | (0.231) | (0.237) | (0.240) |
| FY06 | -0.190 | -0.163 | -0.205 |
|  | (0.227) | (0.235) | (0.237) |
| FY07 | -0.407* | -0.377* | -0.366 |
|  | (0.221) | (0.228) | (0.229) |
| NHG |  | -0.0584 | -0.0964 |
|  |  | (0.321) | (0.325) |
| MT_HSG |  | 0.172 | 0.124 |
|  |  | (0.356) | (0.360) |
| AFQT |  | 0.0183*** | 0.00845 |
|  |  | (0.00421) | (0.0116) |
| GT |  |  | -0.0233 |
|  |  |  | (0.0162) |
| EL |  |  | -0.00291 |
|  |  |  | (0.0135) |
| CL |  |  | 0.0262** |
|  |  |  | (0.0133) |
| MM |  |  | 0.0226* |
|  |  |  | (0.0116) |
| Constant | 1.120*** | -0.199 | -2.011 |
|  | (0.195) | (0.356) | (1.569) |
|  |  |  |  |
| Observations | 722 | 722 | 722 |

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: U.S. Marine Corps, Total Forces Data Warehouse (2012).

Note: Data manipulated by STATA statistical software.

Table 39.    Marginal Effects for Passing MATC Basic Course

| VARIABLES | Model #1 Passed | Model #2 Passed | Model #3 Passed |
|---|---|---|---|
| Black_R | -0.00520 | -0.00732 | 0.0254 |
| | (0.0784) | (0.0782) | (0.0713) |
| Asian_R | 0.136* | 0.152*** | 0.153*** |
| | (0.0738) | (0.0537) | (0.0469) |
| AmerIndian_R | 0.0563 | 0.0777 | 0.0730 |
| | (0.145) | (0.125) | (0.131) |
| Other_R | 0.0189 | 0.0332 | 0.0320 |
| | (0.0523) | (0.0493) | (0.0492) |
| Hispanic_E | -0.0243 | -0.00474 | 0.0105 |
| | (0.0530) | (0.0502) | (0.0483) |
| Black_E | -0.0832 | -0.0413 | -0.0747 |
| | (0.131) | (0.120) | (0.129) |
| Asian_E | -0.198 | -0.260 | -0.268 |
| | (0.266) | (0.299) | (0.299) |
| AmerIndian_E | 0.117 | 0.119 | 0.123* |
| | (0.0847) | (0.0758) | (0.0731) |
| Other_E | -0.0285 | -0.0222 | -0.0168 |
| | (0.0355) | (0.0350) | (0.0347) |
| Female | 0.00161 | 0.00463 | 0.0267 |
| | (0.0589) | (0.0575) | (0.0549) |
| FY99 | 0.0675 | 0.0784 | 0.0892 |
| | (0.0744) | (0.0692) | (0.0629) |
| FY00 | 0.0978 | 0.0836 | 0.101* |
| | (0.0605) | (0.0636) | (0.0563) |
| FY01 | 0.0355 | 0.0246 | 0.0283 |
| | (0.0757) | (0.0774) | (0.0755) |
| FY02 | -0.205** | -0.232*** | -0.210** |
| | (0.0854) | (0.0880) | (0.0873) |
| FY03 | -0.166 | -0.178 | -0.161 |
| | (0.108) | (0.109) | (0.109) |
| FY04 | -0.156 | -0.176 | -0.167 |
| | (0.126) | (0.130) | (0.129) |
| FY05 | -0.0191 | -0.0194 | -0.0115 |
| | (0.0643) | (0.0644) | (0.0633) |
| FY06 | -0.0537 | -0.0444 | -0.0559 |
| | (0.0673) | (0.0670) | (0.0684) |
| FY07 | -0.121* | -0.108 | -0.104 |
| | (0.0715) | (0.0713) | (0.0707) |
| NHG | | -0.0156 | -0.0258 |
| | | (0.0879) | (0.0906) |
| MT_HSG | | 0.0415 | 0.0301 |

|          |          | (0.0790)     | (0.0823)   |
|----------|----------|--------------|------------|
| AFQT     |          | 0.00478***   | 0.00217    |
|          |          | (0.00108)    | (0.00297)  |
| GT       |          |              | -0.00598   |
|          |          |              | (0.00416)  |
| EL       |          |              | -0.000747  |
|          |          |              | (0.00347)  |
| CL       |          |              | 0.00674**  |
|          |          |              | (0.00340)  |
| MM       |          |              | 0.00582*   |
|          |          |              | (0.00297)  |
|          |          |              |            |
| Observations | 722  | 722          | 722        |

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: U.S. Marine Corps, Total Forces Data Warehouse (2012).

Note: Data manipulated by STATA statistical software.


### 4. Model #4 Results

Model #4 indicates that ethnicity, education level, and fiscal year of attending the MATC Basic Course are not statistically significant indicators of revocation from MATC MOSs. When interpreting race, Asians and Others both have a 0.16 lower probability of revoking than whites and a revocation rate equaling 0.04, significant at the 1 percent level. Females have a 0.10 lower probability of revoking than males and a revocation rate equaling 0.10, significant at the 5 percent level.

### 5. Model #5 Results

In addition to the findings in the model #5, Asians have a 0.17 lower probability of revoking than Whites and a revocation rate equaling 0.03. Education level and AFQT scores are not statistically significant indicators of revocation.

### 6. Model #6 Results

In addition to the findings in Models #4 and #5, the statistical significance of the Female variable changes 10 percent. Each additional point scored on the GT composite increases the probability of revocation by 0.009 percentage point. An increase of one

standard deviation in GT scores equals an 8 percent increase in the probability of revoking. These results do not match the findings of previous studies that indicate that an increase in GT scores causes a reduction in revocation.[160] GT scores are significant at the 10t level. EL, CL, and MM composite scores are not statistically significant.

Table 40. Probit Results for Revocation From MATC MOSs

| EQUATION | VARIABLES | Model #4 Revoked | Model #5 Revoked | Model #6 Revoked |
|---|---|---|---|---|
| **Revoked** | Black_R | 0.308 | 0.304 | 0.389 |
| | | (0.312) | (0.316) | (0.325) |
| | Asian_R | -1.063 | -1.121 | -1.041 |
| | | (0.888) | (0.910) | (0.917) |
| | AmerIndian_R | -0.141 | -0.141 | -0.101 |
| | | (0.606) | (0.612) | (0.618) |
| | Other_R | -0.886*** | -0.900*** | -0.875*** |
| | | (0.310) | (0.313) | (0.317) |
| | Hispanic_E | 0.148 | 0.123 | 0.147 |
| | | (0.207) | (0.210) | (0.214) |
| | Black_E | 0.0557 | 0.0214 | -0.0502 |
| | | (0.454) | (0.459) | (0.464) |
| | Asian_E | 0.992 | 1.070 | 1.103 |
| | | (0.803) | (0.815) | (0.824) |
| | AmerIndian_E | 0.0582 | 0.0402 | 0.0624 |
| | | (0.534) | (0.539) | (0.543) |
| | Other_E | -0.142 | -0.157 | -0.142 |
| | | (0.144) | (0.145) | (0.147) |
| | Female | -0.476* | -0.482* | -0.407 |
| | | (0.288) | (0.288) | (0.299) |
| | FY99 | 0.257 | 0.225 | 0.149 |
| | | (0.335) | (0.337) | (0.342) |
| | FY00 | -0.164 | -0.151 | -0.130 |
| | | (0.324) | (0.325) | (0.331) |
| | FY01 | -0.0640 | -0.0482 | 0.00663 |
| | | (0.345) | (0.346) | (0.348) |
| | FY02 | -0.0228 | -0.0126 | 0.00340 |
| | | (0.290) | (0.290) | (0.298) |
| | FY03 | 0.295 | 0.268 | 0.259 |
| | | (0.343) | (0.347) | (0.352) |
| | FY04 | 0.499 | 0.498 | 0.465 |

[160] See Chapter III, Validation of ASVAB Screening Procedures, page 32.

|  |  |  |  |
|---|---|---|---|
|  | (0.427) | (0.429) | (0.435) |
| FY05 | 0.410* | 0.395 | 0.425* |
|  | (0.243) | (0.244) | (0.248) |
| FY06 | 0.322 | 0.306 | 0.340 |
|  | (0.243) | (0.244) | (0.249) |
| FY07 | 0.440* | 0.425* | 0.446* |
|  | (0.244) | (0.244) | (0.249) |
| NHG |  | 0.270 | 0.225 |
|  |  | (0.341) | (0.347) |
| MT_HSG |  | 0.120 | 0.199 |
|  |  | (0.324) | (0.325) |
| AFQT |  | -0.00443 | -0.0110 |
|  |  | (0.00461) | (0.0124) |
| GT |  |  | 0.0346* |
|  |  |  | (0.0187) |
| EL |  |  | 0.0115 |
|  |  |  | (0.0149) |
| CL |  |  | -0.0234 |
|  |  |  | (0.0151) |
| MM |  |  | -0.0119 |
|  |  |  | (0.0129) |
| Constant | -0.991*** | -0.662 | -1.549 |
|  | (0.209) | (0.407) | (1.651) |
|  |  |  |  |
| Observations | 579 | 579 | 579 |

Standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Source: U.S. Marine Corps, Total Forces Data Warehouse (2012).

Note: Data manipulated by STATA statistical software.

Table 41. Marginal Effects for Revocation From MATC MOSs

| VARIABLES | Model #4 Revoked | Model #5 Revoked | Model #6 Revoked |
|---|---|---|---|
| Black_R | 0.0914 | 0.0899 | 0.117 |
| | (0.102) | (0.102) | (0.109) |
| Asian_R | -0.164*** | -0.167*** | -0.158*** |
| | (0.0572) | (0.0527) | (0.0594) |
| AmerIndian_R | -0.0353 | -0.0351 | -0.0253 |
| | (0.141) | (0.143) | (0.147) |
| Other_R | -0.162*** | -0.163*** | -0.158*** |
| | (0.0338) | (0.0335) | (0.0341) |
| Hispanic_E | 0.0413 | 0.0340 | 0.0405 |
| | (0.0606) | (0.0602) | (0.0615) |
| Black_E | 0.0152 | 0.00574 | -0.0129 |
| | (0.127) | (0.124) | (0.116) |
| Asian_E | 0.351 | 0.381 | 0.392 |
| | (0.317) | (0.319) | (0.322) |
| AmerIndian_E | 0.0159 | 0.0109 | 0.0168 |
| | (0.149) | (0.148) | (0.150) |
| Other_E | -0.0374 | -0.0411 | -0.0368 |
| | (0.0375) | (0.0376) | (0.0376) |
| Female | -0.103** | -0.104** | -0.0894* |
| | (0.0486) | (0.0481) | (0.0532) |
| FY99 | 0.0751 | 0.0649 | 0.0414 |
| | (0.107) | (0.105) | (0.100) |
| FY00 | -0.0409 | -0.0378 | -0.0323 |
| | (0.0752) | (0.0761) | (0.0777) |
| FY01 | -0.0166 | -0.0126 | 0.00174 |
| | (0.0873) | (0.0883) | (0.0918) |
| FY02 | -0.00603 | -0.00332 | 0.000892 |
| | (0.0760) | (0.0764) | (0.0782) |
| FY03 | 0.0878 | 0.0789 | 0.0749 |
| | (0.112) | (0.111) | (0.111) |
| FY04 | 0.159 | 0.158 | 0.145 |
| | (0.155) | (0.156) | (0.155) |
| FY05 | 0.121 | 0.116 | 0.124 |
| | (0.0783) | (0.0781) | (0.0795) |
| FY06 | 0.0934 | 0.0884 | 0.0976 |
| | (0.0759) | (0.0758) | (0.0775) |
| FY07 | 0.131 | 0.126 | 0.132 |
| | (0.0800) | (0.0796) | (0.0809) |
| NHG | | 0.0795 | 0.0644 |
| | | (0.110) | (0.108) |
| MT_HSG | | 0.0336 | 0.0564 |

|  |  |  |  |
|---|---|---|---|
|  |  | (0.0946) | (0.0990) |
| AFQT |  | -0.00118 | -0.00289 |
|  |  | (0.00122) | (0.00324) |
| GT |  |  | 0.00905* |
|  |  |  | (0.00487) |
| EL |  |  | 0.00301 |
|  |  |  | (0.00391) |
| CL |  |  | -0.00612 |
|  |  |  | (0.00394) |
| MM |  |  | -0.00310 |
|  |  |  | (0.00337) |
|  |  |  |  |
| Observations | 579 | 579 | 579 |

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: U.S. Marine Corps, Total Forces Data Warehouse (2012).

Note: Data manipulated by STATA statistical software.


## C.     CHAPTER SUMMARY

Six probit models indicate the cumulative marginal effects of demographics, fiscal year attendance of the MATC Basic Course, ability as measured by AFQT, and ASVAB composite scores on passing the MATC Basic Course and revocation from MATC MOSs.  Table 42 outlines the cumulative marginal effect findings from all six models.  These models suggest that Asians and Native Americans are more likely to pass the MATC Course than are Whites and Caucasians, respectively.  Marines who attended the MATC Basic Course in FY 2008 are more likely to pass than are those attending in FYs 2002 and 2007. Whites are more likely to revoke from MATC MOSs than are Asians and Others.  Males are more likely to revoke than are females.  Higher AFQT, CL, and MM scores have a positive effect (increases likelihood) on passing the MATC Basic Course. GT scores are not statistically significant for determining the probability of passing the MATC Basic Course and, contrary to other studies, show a slight positive effect on revoking from MATC MOSs.

Table 42.　Cumulative Marginal Effects Results

| More Likely to Pass the MATC Basic Course | Than… |
|---|---|
| Asians (Race) | Whites |
| Native Americans (Ethnicity) | Caucasians |
| Students in FY 2008 | Students in FYs 2002 and 2007 |
| **More Likely to Revoke From Operational Forces** | **Than…** |
| Whites (Race) | Asians and Others |
| Males | Females |
| **Higher Positive Effect (Increases Likelihood) on Passing the MATC Basic Course as Score Increases:** | |
| AFQT | |
| CL Composite | |
| MM Composite | |
| **Slight Positive Effect (Increases Likelihood) on Revoking from Operating Forces as Score Increases:** | |
| GT Composite | |

Source: U.S. Marine Corps, Total Forces Data Warehouse (2012).

Note: Data manipulated by STATA statistical software.

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# VI. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

## A. SUMMARY

This study attempts to determine the effectiveness of current screening criteria and whether additional screening measures might effectively predict personnel attrition and revocation for Marine Air Traffic Control (MATC) Military Occupational Specialties (MOSs). The study methodology examines the relationship between demographics, education, cognitive abilities, and other performance measures on personnel attrition and revocation. Background information is provided on the following: [1] Marine Corps MOS selection criteria; [2] Armed Services Vocational Aptitude Battery (ASVAB); [3] MATC medical requirements; [4] MATC security clearance requirements; [5] non-cognitive attributes associated with air traffic controllers; and [6] the standard career progression within MATC MOSs. Previous studies are analyzed to address the effects of personnel attrition and revocation on the Marine Corps and MATC specialties. Validation of ASVAB screening procedures, the impact of medical disqualifications, and substantiation of NCAPS testing as a useful non-cognitive screening tool are also evaluated to determine what characteristics of attrition and revocation are applicable when creating a screening metric.

Data for the study were obtained from the Marine Corps Total Forces Data Warehouse (TFDW) and Headquarters Marine Corps, Expeditionary Enablers Branch, Command and Control Group-25 (APX-25). The sample population includes all personnel who attended the MATC Basic Course from fiscal years (FYs) 1999 through 2008 and individuals who were revoked from MATC MOSs. Probit models address the marginal effects of incrementally adding independent variables.

The models test demographic characteristics, effects of fiscal year variation, education, cognitive ability, and ASVAB composite scores on the dependent variables of "passing" the MATC Basic Course and being "revoked" from MATC MOSs. These models suggest that Asians and Native Americans are more likely to pass the MATC Course than are Whites and Caucasians, respectively. Marines who attended the MATC

Basic Course in FY02 or FY07 are more likely to attrite than are those attending in FY08. Higher AFQT, CL, and MM scores have a positive effect on passing the MATC Basic Course. Asians and Others are less likely to revoke from MATC MOSs than are Whites. Females are less likely to revoke than are males. GT scores are not statistically significant in determining the probability of passing the MATC Basic Course and, contrary to other studies, the present study shows a slight positive effect (increases likelihood) of increased GT scores on revoking from MATC MOSs.

## B.    CONCLUSIONS

The results of the present study indicate that 20 percent of Marines who attended the MATC Basic Course from FYs 1999–2008 attrited. In contrast, a 2011 study by Northrop Grumman shows that 28 percent of the Marines attending the MATC Basic Course from FYs 2008–2011 attrited.[161] The reasons for this apparent rise in attrition over more recent years could relate to the smaller sample size used in the Northrop Grumman study, changes in the ability of students to pass the MATC Basic Course, changes in the method of instruction, Marine Corps policy changes, or other factors, including differences in study methodologies. Without further research, there is no way of explaining the sizable increase in reported attrition. Additionally, the present study shows that 20 percent of MATC personnel in the operational forces were revoked during FY 1999–FY 2008. By comparison, the 2011 study by Northrop Grumman found a revocation rate of 15.6 percent from FY 1994 to FY 2010.[162] The reasons for this difference could be lower revocation rates from FY 1994–FY 1999, decreasing the Northrop Grumman average, dissimilar sample sizes, differences in analytical methods, or a combination of several factors.

The majority of personnel who attended the MATC Basic Course between FY 1999–FY 2008 are White (80 percent), Caucasian (38 percent), male (93 percent), and have 12 years of education (94 percent). Asians and Native Americans have an

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[161] Marine Corps Studies Program Support, *Marine Air Traffic Control Training and Revocations Study*, ES-2.

[162] Ibid., ES-4.

increased probability of passing. Higher CL and MM scores correlate with a higher probability of passing; however, the MM scores are only significant at a 10 percent level. Most statistical studies require a significance level of 5 percent or less to be considered valid indicators for correlation. Additionally, the percentage point values for CL and MM scores are low, suggesting they are not suitable for augmenting current selection criteria. For revocation, differences in ethnicity, fiscal years, education, and ASVAB test scores are not statistically significant. A curious finding is that higher GT composite scores indicate a slight decrease in revocation. The reason for this could relate to the level of statistical significance used or the sample size being too small and, therefore, skewing the results.

A comparison of fiscal years indicates that Marines who attended the MATC Basic Course are more likely to attrite in FYs 2002 and 2007 than in FY 2008. The rise in attrition for these two years could be from stop-loss policies enacted during the wars in Iraq and Afghanistan, increased deployment tempo, a drop in ASVAB test scores, changes in instructional techniques, command leadership priorities, or other reasons. Additional research, beyond the scope of this study, is required to ascertain these causes.

Screening to enter MATC training measures cognitive ability by a GT score of 110 or higher. From the sample, however, 202 individuals (28 percent of the total sample) have a GT score below 110. This study finds that GT scores are not a statistically significant indicator of passing, and shows an abnormal increase in revocation when GT scores increase. These results suggest that changing the GT score selection criterion is not warranted until the findings of this study are validated.

Screening also includes measuring physical ability through a Class II medical qualification and possessing normal color vision. The data provided from TFDW and APX-25 for this study indicate that 4 percent of the individuals sampled are not physically qualified (NPQ) to remain in MATC MOSs. Screening for medical conditions related to revocation is problematic, however; medical disqualifiers can occur at any point in a Marine's career. Additionally, the 2011 Northrop Grumman study indicates that, between FY 2008–FY 2011, an average of 4 percent of personnel who attended the

MATC Basic Course attrited for medical reasons.[163] Some of these medical attrites occurred due to conditions that were most likely detectable prior to entering training, such as eyesight not correctable to 20/20 (representing the 29 percent of the individuals attrited from the MATC Basic Course in FY 2008–FY 2011 for nonacademic reasons).[164] Lowering the percentage of attrition for detectable medical problems would require increased thoroughness during medical screening at MEPS, recruit training, and NAS Pensacola prior to entering the MATC Basic Course.

The final screening criterion to enter MATC training is obtaining Secret clearance eligibility. Both this study and the 2011 Northrop Grumman study found less than 1 percent of attrition or revocation occurred due to loss or denial of a security clearance. These findings suggest no additional screening metrics are required for security clearances.

## C.    RECOMMENDATIONS

The purpose of this study is to examine the relationship between demographics, education level, ASVAB test scores, and other performance characteristics to determine the likelihood of personnel attrition from the MATC Basic Course or revocation from MATC MOSs. The study accomplishes this by measuring the effectiveness of current screening criteria in predicting personnel attrition and revocation in MATC MOSs and ascertaining whether additional screening criteria will increase prediction validity for future models.

The results of the statistical portion of this study suggest that the current screening criteria associated with AFQT scores and ASVAB composite scores do not require modification. However, other MATC personnel attrition and revocation factors exist beyond the statistical analysis portion of this study. A comprehensive review of previous studies suggests that personnel attrition and revocation rates can be reduced by including the following: [1] improved medical screening of Marines prior to their entering the MATC Basic Course; [2] adding non-cognitive testing, such as NCAPS, in selection

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[163] Ibid., 3.7.

[164] Ibid.

criteria; and [3] conducting an economic analysis between the sunk costs associated with attrition from the MATC Basic Course, which normally occurs within the first 6–8 months of enlisted service, and revocation from operational forces later in a Marine's career.

Personnel arriving at MEPS and recruit training who have already received an aviation-related occupational field (OccFld) should receive the full Class III Naval aeromedical examination. Receiving a Class III medical qualification normally requires the approval of a Naval Flight Surgeon. It might be difficult to find the funding needed to increase the number of flight surgeons available for aviation-related MEPS and recruit screening. However, flight surgeons are only required at the end of a medical screening to validate that an individual meets the medical requirements for service within an aviation MOS. Medical personnel currently serving at MEPS and at recruit training depots could handle the screening portion prior to final approval by a flight surgeon. This recommendation would miss "open contract" recruits, because they do not receive their MOS until after completing recruit training; however, it would still affect a significant number of individuals who have an aviation-specific OccFld.

Screening for non-cognitive attributes associated with personality, behavior, and interests could be added to existing procedures for evaluating Marine Corps candidates prior to their receiving a guaranteed OccFld or MOS. The NCAPS is a non-cognitive screening tool currently undergoing validation for use with MATC personnel. When attempting to fill manpower vacancies, NCAPS could provide manpower and recruiting personnel with an additional screening metric. The success of NCAPS in reducing Basic Underwater Demolition/SEALs (BUD/S) attrition within U.S. Navy Sea, Air, and Land (SEAL) special warfare teams suggests that it may also aid in reducing attrition and revocation for other military occupations.

Future studies should explore the correlation between the sunk costs associated with attrition from the MATC Basic Course, which normally occurs within the first 6–8 months of enlisted service, and revocation from operational forces later in a Marine's career. This type of study would prove useful by focusing resources where the problem is more economically detrimental. As budgetary constraints on manpower spending

tighten throughout the defense establishment, fewer fiscal resources could be targeted toward solving attrition issues.  A study determining the economic value of the loss of a Marine Air Traffic Controller during different stages of a typical career would aid in determining where to focus finite resources to reduce the impact of personnel replacement.

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